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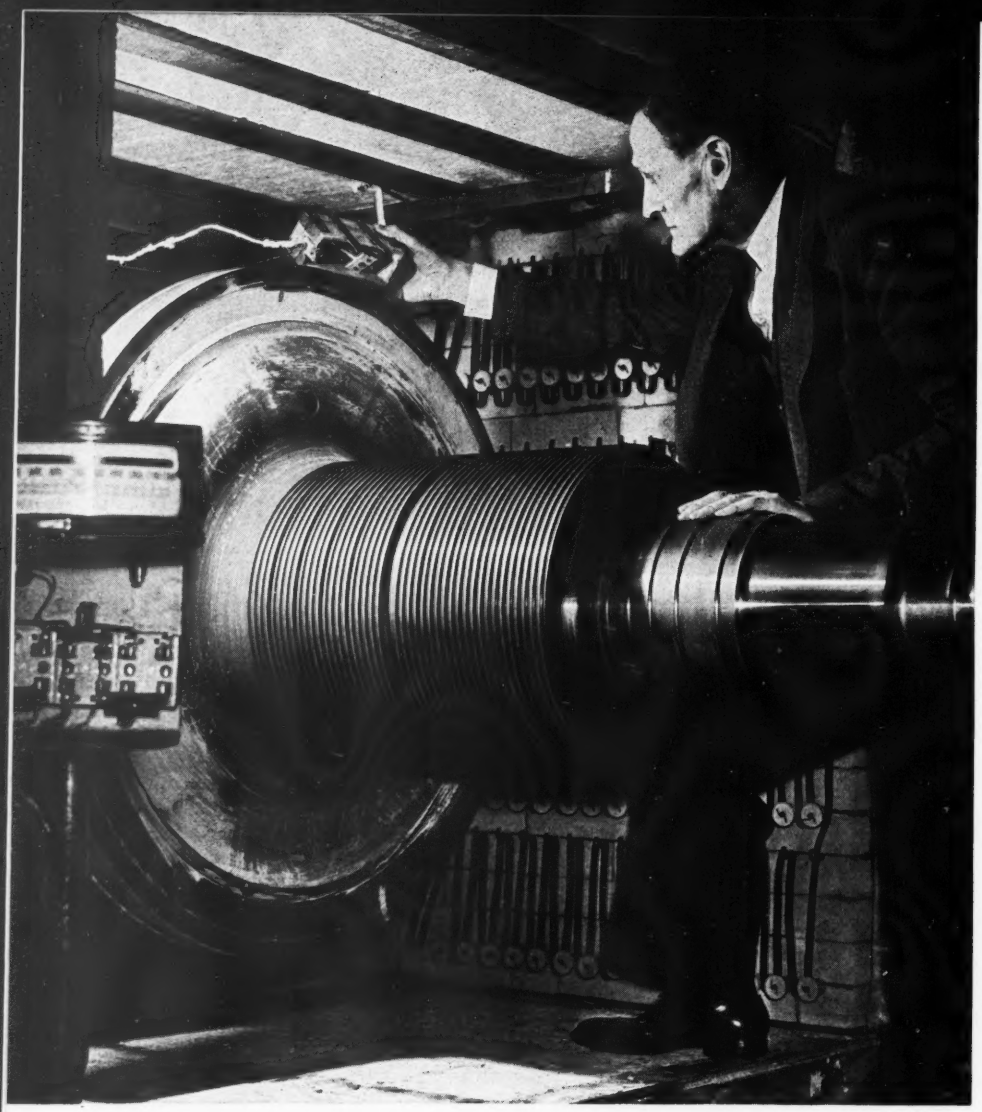


Making Turbine Shafts Run True

S. HOMER WEAVER, General Electric engineer who recently received a Charles A. Coffin award from his company for his method of "baking" permanent straightness into steam turbine shafts and rotors, inspecting one of the thermocouples before a run. Turbine rotors like this one on the lathe inside the electric oven weigh up to ten tons and must retain perfect straightness at operating speeds of 3600 r.p.m. and at 950 deg. F. ¶In the Weaver process, the machined-straight shaft or rotor is suspended in a standard lathe bed. The electric oven, sectionalized for different length requirements, is closed about it and controlled heat is applied through the strip heaters on the wall. The rotor is turned at 2 r.p.m. and thermocouples riding on it provide temperature readings. As the oven heat is raised the rotor loses its straightness. Sliding rods passed through the wall and riding against the turning rotor indicate increasing shaft deflection as the temperature goes up. Then, at a certain critical temperature a straightness is restored which is not affected by subsequent temperature or temperature changes. The treatment is, thus, a true stabilizing cure. ¶Before Mr. Weaver developed his process, metallurgists had been of the opinion that steel was stable at all temperatures encountered in turbine operation and not subject to any metallurgical effects after strain relief, was completed.

WITH THE EDITORS

Where's the Yardstick?

EVER SINCE the United States Government started the development of power on the Tennessee River, the advocates of public ownership have harassed privately owned electric utility companies with threats of extinction, and in many cases their threats have been carried through to completion, albeit the owners were paid for their property. Throughout this whole campaign for socialized power utilities, the advocates have emphasized the need for a "yardstick" with which to compare electric rates and determine the fairness—at least, so they said.

Recently signed contracts for Bonneville power and statements by the Secretary of Interior indicate that the "yardstick" has been lost somewhere between the Tennessee and Columbia Rivers. For if T. V. A. rates are to be considered standard, then Bonneville is a chiseler.

Here are the facts as stated in Government news releases: The Aluminum Company of America pays $24.00 per kilowatt-year for firm power it receives from T. V. A. This same company has recently contracted for firm power from Bonneville for which it will pay only $17.50 per kilowatt-year. That is a reduction of more than ¼. Secretary Ickes has approved the contracts and in regard to Bonneville makes the following statement:

"This new major power sale assures the success of the Bonneville project. President Roosevelt indicated that it would be a benefit to the national economy if metal industries could be established in the northwest where none existed before. In the past few months we have not only concluded the two Aluminum contracts, which extended that industry west of the Mississippi into new territory for the first time, but we have also signed a 20 year contract to supply Bonneville power to the Sierra Iron Company, which is establishing the steel industry in the area for the first time. More contracts will be announced in the future."

From this statement of the success of the project, emphasis is taken away from the ability of Government projects to generate and sell electric power cheaper than privately owned utilities and placed on the social aims of the project—that of building up the industry of the territory.

At Bonneville, "the main object of a public power system," as stated over a year ago by the late J. D. Ross, while he was administrator of the project, "is to lighten the burdens and promote the industry of its patrons. To this end all branches of industry will be encouraged, irrigation, mining, wood products such as pulp and paper, rayon and plywood, farming and fertilizers, and chemical manufacture." Rates in the home, he stated, will receive special consideration. The price to industries at the dam was set at $14.50 per kilowatt-year. Under these conditions the projects cannot be expected to be self liquidating as power generating plants and will continue to require Government financial assistance.

Subsidized power is not competitive power. The Government may be justified in developing the industry of a community but it certainly is not justified in comparing rates of plants that must be subsidized in order to carry on with those of plants that are completely self supporting. It is to be hoped that the idea of establishing a "yardstick" based on rates that will not completely support the utility project will be abandoned.

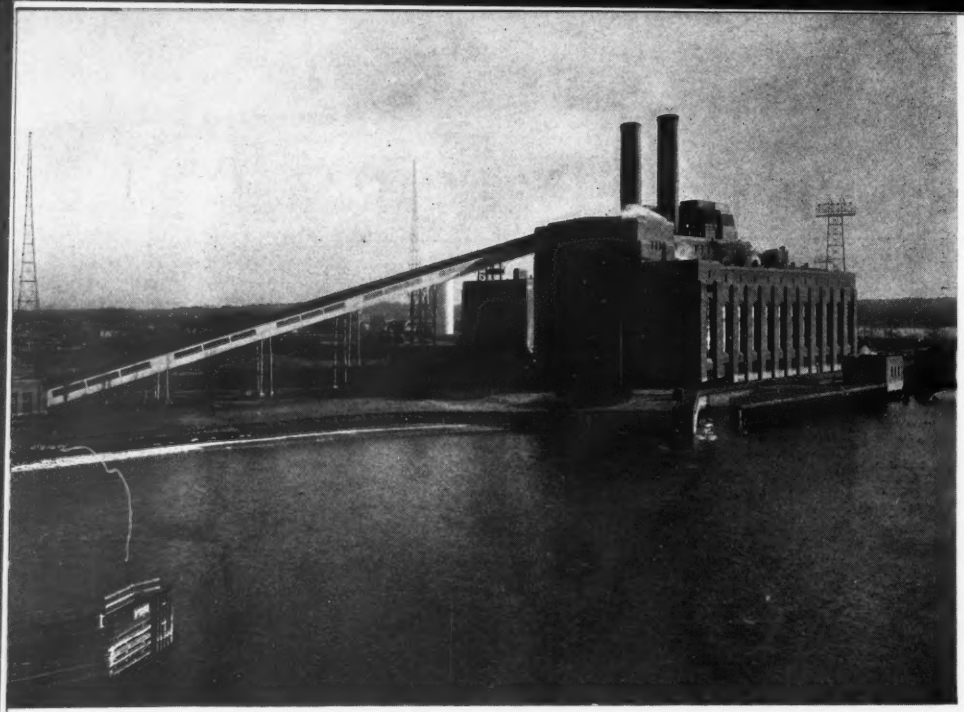
Unhampered by Experience

TO THE EXPERIENCED engineer it is an inspiration to get the views and theories of college students who are preparing a foundation for an engineering career. Such an opportunity presents itself each year at the Student Conferences of the American Society of Mechanical Engineers where students contest for prizes in the presentation of papers on subjects of interest to mechanical engineers.

These young men conduct all phases of the technical session except the judging of the contest. In the presentation lantern slides, movie films, charts, blackboard drawings and models are used to clarify the addresses. The technique of using the public address system is studied, and many of the contestants have so familiarized themselves with their subjects that they speak from brief notes or entirely without memory aids. The question period is also illuminating for it brings out the author's familiarity with the subject of his paper.

Above all, the auditor, familiar with the topic under discussion, is impressed with the confidence the young men have in the truth of the statements they make and the workability of the designs they have made on paper. Failure of a theory they have reasoned out from premises recognized as sound seems out of the question and they are fired with an enthusiasm that is contagious. Visionary as some of the ideas presented by these boys may be, they may prove to be of extreme value to society if put into the hands of a master craftsman who has the ability to convert nebular ideas into physical forms.

New ideas, fresh theories, the latest technique available to scientists and enthusiasm are contributions young engineers can make to the profession. Too frequently unsuccessful experiences dampen the ardor of older men for experimentation which their knowledge eminently fits them to undertake. Such experiences may have been under circumstances that can be modified today. Physics, chemistry and metallurgy have given an insight into many mysteries of the past generation and it is no longer judicious to allow old experiences to build prejudice against new and untried ideas. It is impossible to measure the value to society that has resulted from minds that have been unhampered by experience.



Boston

A recent view at Edgar showing the new precipitators on roof

EDGAR STATION of the Boston Edison Co. will occupy an important place in the history of steam power development in this country because it was at Edgar Station that the first commercially practicable 1200 lb. pressure boiler and turbine was installed. This installation in 1925 marked the first use of steam pressures for power generation considerably above the, then, normal limits of about 750 lb. per sq. in. Since that time the use of high steam pressures has been far and wide but all of this development dates back to this first successful installation at Edgar Station at Weymouth, Massachusetts, near Boston. At the time this installation commanded nationwide interest among power engineers.

This first installation at Edgar consisted of two 36,000 kw. turbine generators supplied with steam at a normal pressure of 350 lb. per sq. in. 700 deg. F. and one 3360 kw. back pressure turbine taking steam up to 1200 lb. pressure 700 deg. F. and exhausting into the 375 lb. system. Steam was supplied by three 375 lb. boilers and one 1200 lb. boiler. These four boilers were numbered 1 to 4, number 3 being the 1200 lb. unit.

The 3360 kw. high pressure unit was somewhat experimental in nature but proved successful, so much so, in fact, that when the station was extended during the years 1926 to 1929, two more high pressure turbine units were installed, together with a 60,000 kw. low pressure unit. The high pressure units were rated at 12,500 and 15,625 kv-a. respectively. These new installations also involved four new boilers, all designed for operation at 1400 lb. pressure. These units were numbered 5 to 8. These boilers, as were also those comprising the initial installation, were all stoker fired. The five high pressure units in addition to the usual superheater and economizer surfaces were also provided with a steam reheater to restore the temperature of the exhaust steam from the high pressure turbines to around 750 deg. before passing into the 375 lb. system.

Since 1929 no fundamental changes or additions were made in the station but towards the latter part of 1937 it became desirable to increase the steaming capacity of the 1400 lb. boilers and studies were made as to how this might best be accomplished.

A cross section of the station, showing the 1400 lb. boilers before rebuilding is shown in Fig. 2. After careful analysis of all the factors involved it was decided to change the method of firing from stokers to pulverized coal and oil. This change permitted a substantial increase in furnace volume and in water cooled furnace wall area. These fundamental changes in the boiler necessitated other changes in the draft equipment and in the auxiliary apparatus which raised the total output of the four boilers from approximately 766,000 lb. per hr. to 1,200,000 lb. per hr.

This program was carried out during 1938 and 1939 without interference to the station output by scheduling and completing the work on one boiler at a time and having the other three available at all times. The engineering was carried on by Jackson and Moreland, consulting engineers of Boston and New York. A cross section of the boiler room showing the arrangement of equipment after the changes were made is shown in Fig. 3.

The conversion to pulverized coal made it desirable to provide more effective means for collecting flue dust and so electrostatic precipitators were installed. These are shown on the roof.

The addition of these precipitators, the relocation and the increase in the capacity and size of the induced draft fans, and the rearrangement of flues and ducts, imposed additional loads of considerable magnitude at the higher elevations of the existing building structure which required not only the reinforcing of existing building columns but necessitated raising the old roof level some 16 ft. to provide a new fan floor for the larger induced draft fans. The new roof level, with dust recovery equipment weighing about 530 tons, exclusive of the supporting structure, located above it, is approximately 141 feet above ground level.

Edison Co. Increases 1400 lb. Boiler Output at Edgar

BY C. H. DANFORTH

Engineer, Jackson & Moreland
Boston, Massachusetts

Since oil burning equipment was also installed, primarily to relay pulverizer outage, rather limited fuel oil storage facilities were installed at this time. They consist of a single underground tank 25 ft. in diameter and 8 ft. high, having a capacity of approximately 25,000 gal.

The ash storage facilities consist of an outside elevated bin of 150 ton capacity permitting direct loading into trucks for disposal.

Another element in the change was the addition of a new boiler feed pump to meet the increased rating of the boilers. Since there was no room available in the station, this pump, which is a very large one, was installed in an extension of the food pump bay.

As shown in Fig. 1, the eight boilers in the station are installed in two parallel rows. Boilers Nos. 1, 3, 5 and 7 in one row are served by a single superimposed stack between boilers 3 and 5. On the opposite side of the boiler house are Boilers Nos. 2, 4, 6 and 8 served by a single superimposed stack between boilers 4 and 6. The four 1400 lb. units, Nos. 5, 6, 7 and 8, were altered for pulverized coal and oil firing.

Boilers No. 5 and 6

Boilers Nos. 5 and 6 are sectional header type Babcock & Wilcox units consisting of a lower boiler tube bank of 3¼ in. diameter tubes, 7 tubes high and having alternate tubes omitted in the lower rows to form a slag screen, an interdeck superheater, an upper bank of 2 in. diameter tubes, 10 tubes high, and a 370 lb. per sq. in. reheater located between the upper boiler tube bank and the boiler roof. These two boilers are 3 pass baffled and have an economizer and air heater arranged above the boiler proper.

To accommodate the increased steaming rate, provision for better boiler circulation was made by removing the conventional nipples between the upper and lower tube banks and installing separate circulators between the lower bank of boiler tubes and the drum and the upper bank of boiler tubes and the drum, and as a further precaution, restrictors will be installed in the boiler headers.

Changes in the primary superheater consisted in removing the outer loop of superheater tubes across the entire width of the superheater and the installation of a steam cooled baffle between the saturated and superheated steam headers. The flow through the baffle supporting tubes is controlled by means of orifice plugs. The rebuilt superheaters are designed for a steam temperature of 750 deg. F. at the increased rating.

The reheaters were retubed for a steam temperature of 750° at the new rating of the boilers.

The airheaters were rebuilt in order to provide a straight tube design with tube sheets at right angles to the tube.

Specific Changes in Boilers No. 7 and 8

Boilers No. 7 and 8 are single pass, Babcock & Wilcox, sectional header boilers consisting of a single bank of 3¼ in. diameter tubes, 7 tubes high, having alternate tubes omitted in the lower rows to form a

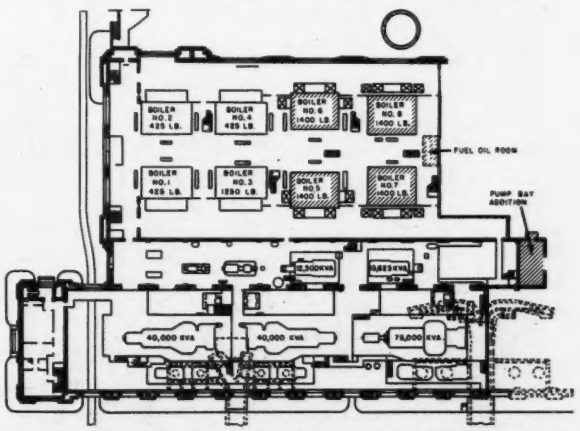


Fig. 1. Plan of Edgar station showing general arrangement of equipment

slag screen, and have a tube surface of about 6900 sq. ft. compared with approximately 15,000 sq. ft. in the case of Boilers No. 5 and 6. These units have single pass, 1400 lb. superheaters, whereas the superheaters of Boilers No. 5 and 6 are 3 pass. The economizer and air heater arrangement is essentially the same as for Boilers No. 5 and 6 but the reheaters are installed above the boilers beside the economizers.

No change was made to superheater, reheater, ecomomizer or air heaters on Boilers No. 7 and 8 except in the method of controlling the reheat temperature which is now accomplished by desuperheating equipment arranged to control the temperature of the steam entering the second tube bank so that a final reheat temperature of 750 deg. F. is obtained and the addition of restrictors in the boiler uptake headers to control the circulation.

Furnaces of All Boilers Enlarged

As a consequence of the removal of the stokers and the lowering of the furnace floor, the combustion chambers of all the four boilers were considerably enlarged. All the new furnaces were made identical and were provided with all new water walls except the downtake water wall. As shown in the elevations, the new arrangement has a single inclined furnace floor sloping downward from the uptake or burner wall toward the ash pit at the downtake end of the boiler.

The water cooled walls are of partial stud construction above the level of the top of the inclined furnace floor, and block covered below. The uptake or burner wall is of bare tube construction with solid refractory backing at the burner section and unit suspended refractory backing above. The inclined floor is block covered.

The downtake walls of the boilers were retained without change except in the case of Boilers No. 5 and 6 which were wholly block covered and partial studding has now been used to replace the blocks on the lower half of the wall. Downtake walls on Boilers No. 7 and 8 were full studded and were not changed. A unit supported refractory closure wall was installed between the downtake wall and the ash hopper.

Sufficient cooling effect is obtained from the water wall construction to give a dry ash suitable for handling with a vacuum system of disposal. At 300,000 lb. per hr. steam output, the furnace liberation is about 26,300 B.t.u. per hr. when firing all coal and about 26,450 B.t.u. when firing all oil fuel.

The furnaces are approximately 28 ft. wide between side walls and have a depth of about 18 ft. between the burner wall and the downtake wall; from the center line of the upper row of burners, the distance to the lowest boiler slag screen tube is about 16 ft. 6 in., and from the lower row of burners, this distance is 20 ft. 6 in.

Coal Handling

The coal transport system from yard storage to the station bunkers remains unchanged except that a magnetic separator pulley has been installed at the discharge end of the main conveyor where the coal is discharged to the distributing belts within the boiler house.

A feature of interest, and one that may well prove its worth at times, is the installation of a 4½ ton coal hopper above each mill. Each of these hoppers is supplied by two 24 in. diameter coal spouts from the overhead station bunkers. These hoppers form a 20 min. to a half hour reserve supply in case of stoppage in the coal spouts leading from the bunkers.

Another feature is that the new arrangement of hoppers and spouts retains the use of the original coal larry for running tests or, when necessary, to draw coal from other bunker sections for use of these boilers. A number of separate spouts are available, distributed along the length of the bunkers for larry loading.

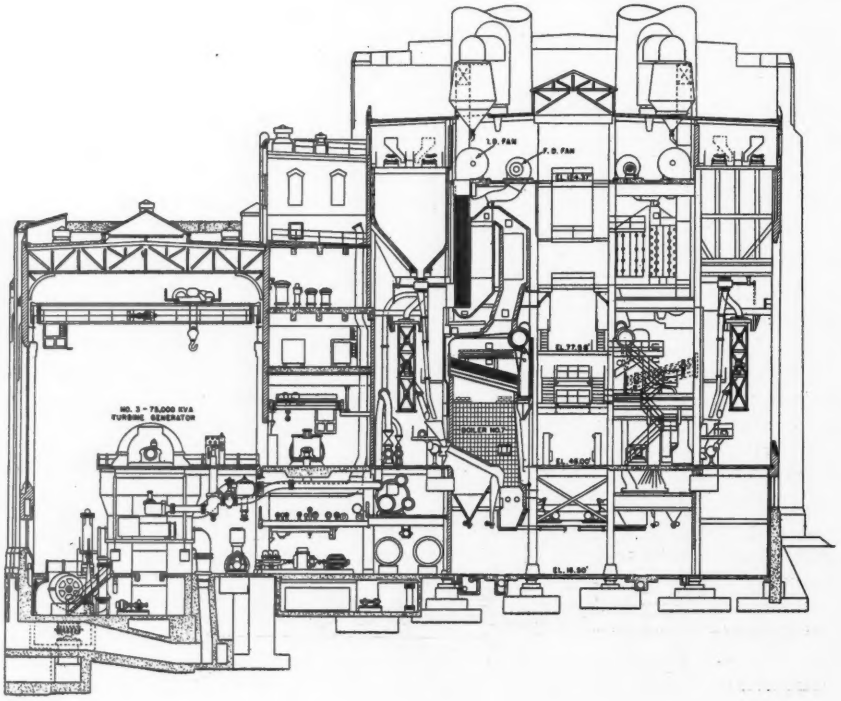


Fig. 2. Cross sectional elevation showing the arrangement of boiler equipment before the alterations were made. Note that the forced and induced draft fans are both on the same level. With this arrangement the boilers were stoker fired and the furnaces only partly water cooled

Fuel Burning Equipment

The problem of locating the pulverizing mills in the space available was one that required considerable

study in its solution and was accomplished by placing them under the sloping floors of the furnaces as indicated on the elevation. Two pulverizer mills were provided for each boiler, each with a capacity of 9 t. per hr. The mill feeders are located on the firing floor.

Burner equipment consists of 6 circular combination coal and oil burners mounted in a wind box which has been arranged to provide individual compartments under damper control; this control being in addition to the regular burner regulating damper. The burners are installed in two horizontal rows of three, staggered to give equal burner spacing across the width of the boiler. The piping arrangement between the mills and the burners is such that the lower row of burners is supplied from one mill and the upper row from the other.

Oil burner capacity equal to the mill capacity has been provided, and under ordinary load carrying conditions, the burners are operated as straight mechanical atomizing units. Steam atomizing provisions have also been installed for use in starting up and for light load conditions.

The fuel oil piping system at each boiler has been provided with an emergency hand reset shut off valve which closes on low oil pressure, also on loss of fan power.

The fuel oil handling and heating equipment is located in a fireproof room in the ash room on grade 16, the lowest level in the building. This consists of one 40 g.p.m. pump for load carrying and one 10 g.p.m. pump for ignition or banking conditions, arranged so that both pumps may be run in parallel when conditions require the combined capacity.

Under ordinary operating conditions the oil is delivered to the furnace at a pressure of from 200 to 250 lb. per sq. in. at a temperature of from 200 to 220 deg. F. Two fuel oil heaters are provided, one of 15,000 lb. per hr. capacity for the large pump and the other of 500 lb. capacity for the small pump. As installed, the fuel oil system provides ample protection against the loss of one or two pulverizers and has been arranged so that only the addition of pumping equipment, heaters and greater storage facilities would be necessary to fire wholly with oil.

Ash and Dust Handling

The four Cottrell precipitators for the removal of flue dust are located on the roof as shown in the drawings and photographs. The equipment for each boiler consists of four 15 duct units set two units wide by two units long, designed to handle 190,000 c.f.m. of flue gas at 445 deg. F.

For charging these precipitators, five sets (one spare) of electrical equipment, using half wave rectification are installed, three sets in one substation and two in another, all controlled, however, from a single

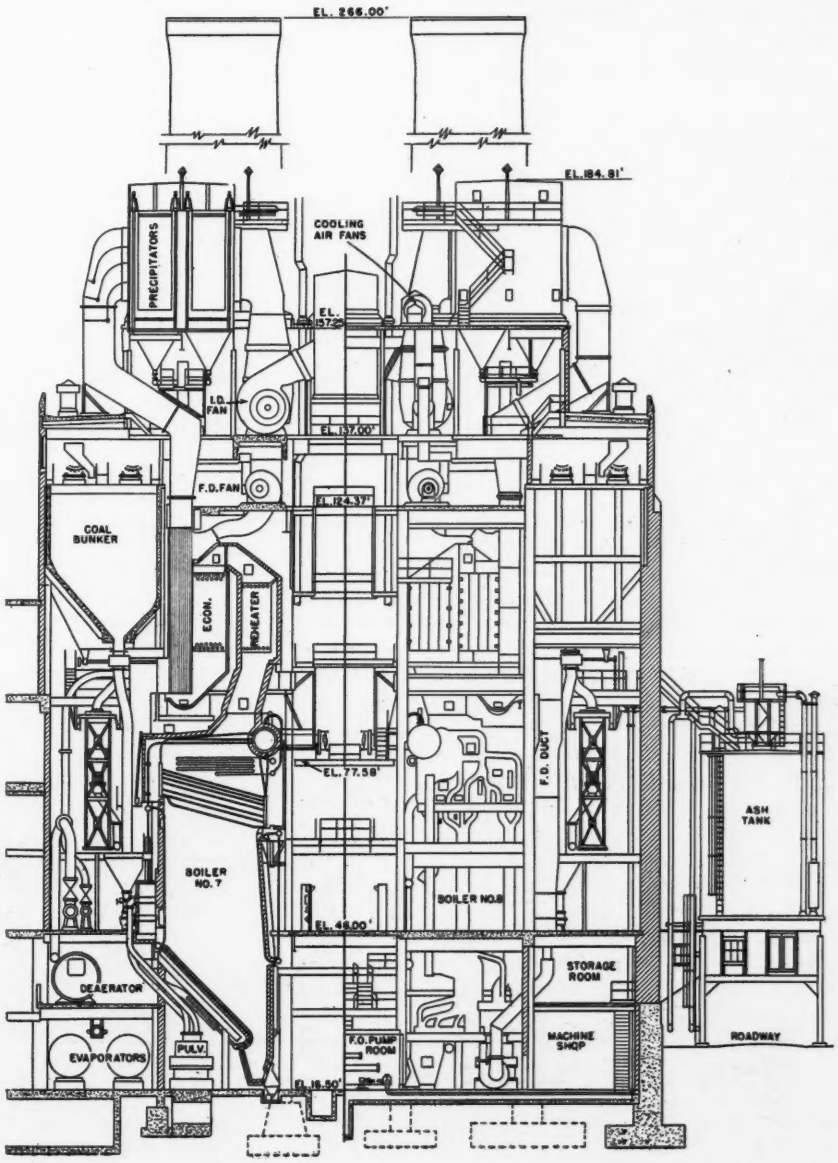


Fig. 3. Cross sectional elevation of boiler room showing the new arrangement. The stokers have been removed and pulverized coal burning equipment installed in its place. Precipitating equipment has been installed on the roof and the old induced draft fans replaced with larger units on a higher level

switchboard. This made the most desirable arrangement with the boilers set in two rows. Individual transformers step up 550 v. current to approximately 75,000 v. and variations in secondary voltage below 75,000 are controlled by reducing the 550 v. primary voltage at the switchboard. Filter units to reduce radio interference from the rectifiers are installed.

Each precipitator unit has its individual dust hopper and provides a combined storage of approximately 20 tons per boiler. The hoppers are fitted with vibrators and unload to the pneumatic system by means of rotating feeders discharging into a 6 in. conveying line. The fly ash hoppers located between the economizers and the air heaters are cleaned by self-feeding ash intakes discharging into a 6 in. line.

The boiler ash hoppers have a storage capacity of approximately 10 tons each. They are of steel plate construction, lined with 5 in. of insulating brick and 4½ in. of fire brick and are arranged for manual cleaning through four access doors into self-feeding intakes which discharge into an 8 in. conveying line located in a trench in the ash room.

The vacuum producing equipment for normal operation consists of a mechanical rotary exhauster of the positive type with a displacement of 11.9 cu. ft. per revolution. The blower is V-belt driven by a 100 hp. motor and is located on the unloading platform under the yard ash storage bin. An auxiliary steam exhauster has also been provided for use in case of blower failure. The ash storage bin is unloaded through a star feeder discharging into a rotary dustless unloader. An arrangement of cooling piping has been installed at the storage tank between the receiver and the bag filter in order to reduce the temperature of the exhaust before reaching the fabric bags.

Draft Equipment

As already pointed out, the increase in the rating of the boilers made necessary larger induced draft fans and since these could not be installed in the existing space, the roof was raised and the fans installed on a new floor just above the forced draft fan level. These new induced draft fans, which are motor driven vane controlled units, are located on the outlet side of the precipitator on each boiler; each fan is double width, double inlet and has a capacity of 190,000 c.f.m. of 440 deg. F. flue gas. The system resistance provided for from the furnace to the stack is 22 in. of water for boilers No. 5 and 6 and 25 in. of water for boilers No 7 and 8. This difference was taken into consideration in selecting the motors for the two sets of fans. The fans on boilers Nos. 5 and 6 are driven by 1000 hp. motors while those for the fans on boilers Nos. 7 and 8 are 1250 hp. motors. These motors are all 1200 r.p.m., 2300 v., 3 phase, 60 cycle squirrel cage induction motors for across the line starting, and are direct connected to the fans through flexible couplings.

The existing forced draft fans were of sufficient capacity to meet the increased output and were retained. No change in their location was necessary. The forced draft fans on boilers Nos. 5 and 6 have a 125 hp. 870 r.p.m. motor coupled to one end of the fan shaft and a 300 hp. 1165 r.p.m. motor coupled to the other end. Speed regulation for these fans is obtained by a drum controller. The forced draft fans on boilers Nos. 7 and 8 are vane controlled and have a 50 hp., 685 r.p.m. motor coupled to one end of the fan shaft and a 300 hp., 1170 r.p.m. motor coupled to the other end. The fans for each boiler have a capacity of 47,500 c.f.m. at 11.2 in. for boilers Nos. 5 and 6 and 12.8 in. for boilers Nos. 7 and 8.

The fans for supplying cooling air to the induced draft fan motors are mounted on the roof.

Combustion Control

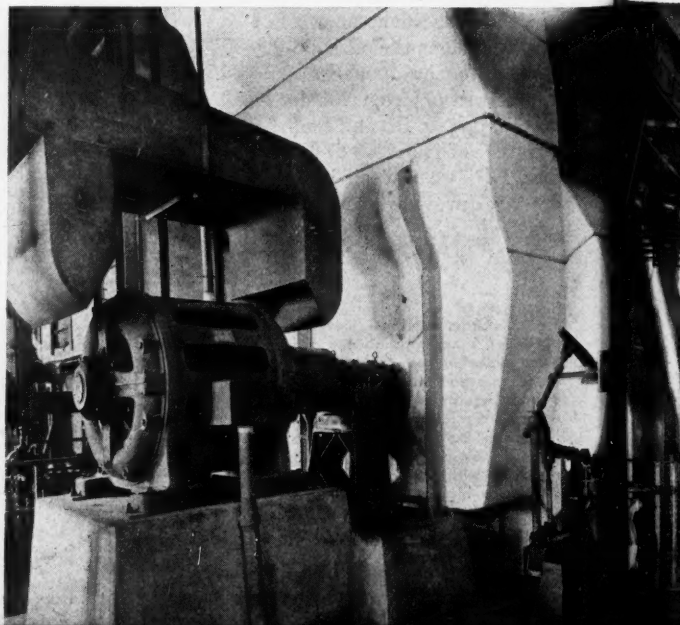
The operation of the boilers is controlled by an automatic combustion control system. This is a compressed air actuated hand or automatic system arranged with air failure locks to prevent loss of steam generation on loss of control air pressure. Normal control air is from the station compressed air system, relayed by two 46 c.f.m. motor driven compressors, arranged to cut into service automatically at a predetermined low air pressure.

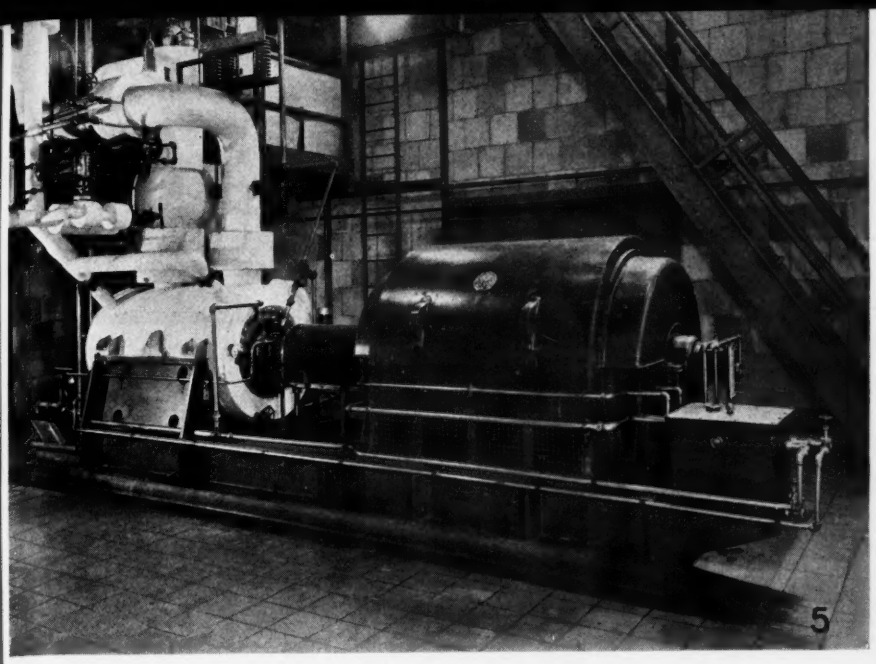
As arranged, the furnace pressure controls the induced draft fans while the steam flow controls the forced draft fans and the pulverized coal fuel supply. Electrical interlocks control the sequence of starting operation in the following order: 1, the induced draft fan; 2, the forced draft fan; 3, the pulverizer mill, and 4, the mill feeder, all of which are motor driven. For protection in starting and in case of loss of power, all equipment beyond the point of electrical failure is automatically tripped out of service.

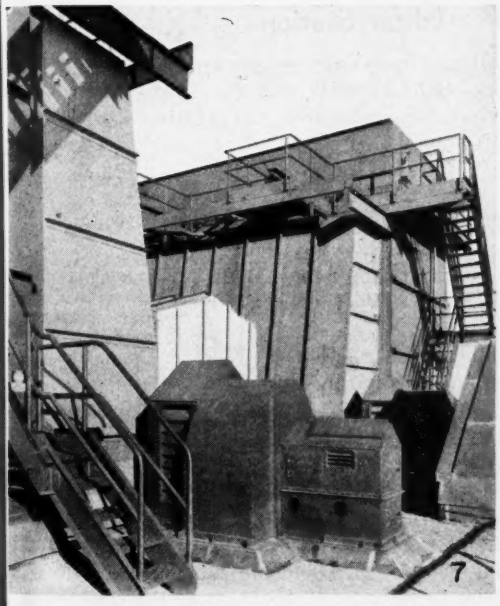
Smoke recorders have been installed on each of the boilers and are equipped with signals at each

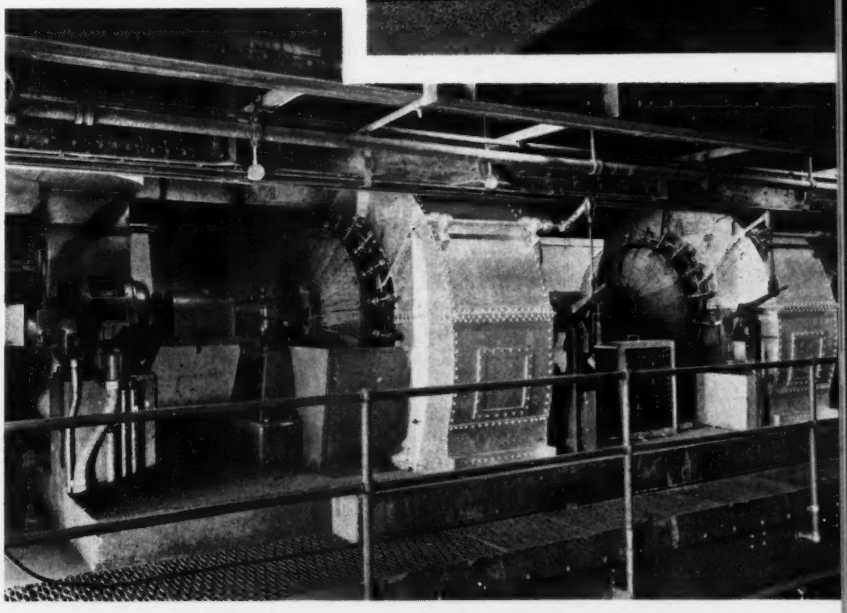
PHOTOGRAPHS OF THE CHANGES AT EDGAR

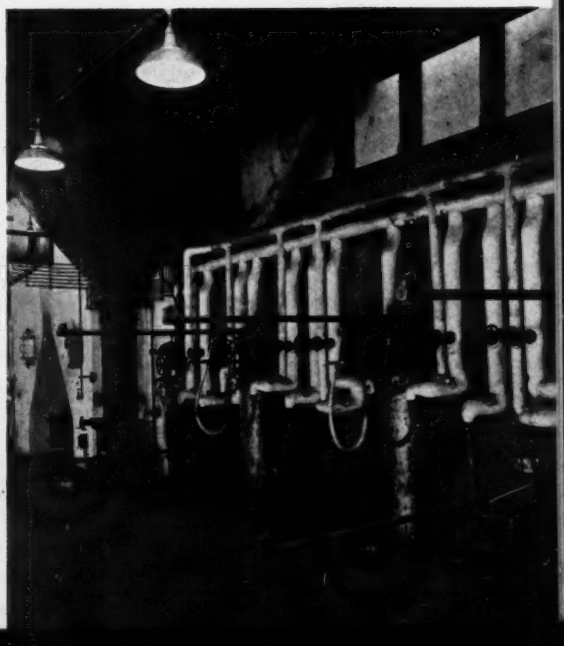
Fig. 4. (Below) The induced draft fans showing how cooling air is supplied to the motors. Fig. 5. The new 700,000 lb. per hr. boiler feed pump with its 1750 hp. motor. Fig. 6. The electrostatic precipitators. Fig. 7. Another view of the precipitators showing the cooling air fans for the induced draft fans in the foreground. Fig. 8. (Center right) The forced draft fans. Fig. 9 (lower left) The operating floor. Fig. 10 (lower right) The combination coal and oil firing equipment











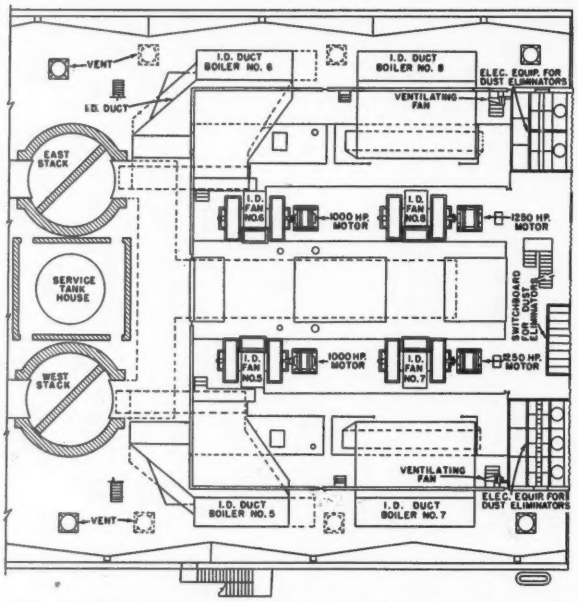


Fig. 11. Plan showing arrangement of equipment in upper part of the boiler room

boiler gage board to notify the operators in case of smoky firing conditions.

The New Boiler Feed Pump

It is not often that the addition of a single boiler feed pump requires an addition to a building but in this case this was necessary. This pump was necessary because of the increase in the steaming capacity of the boilers and is a unit of unusually large size and capacity. A view of this unit is shown in Fig. 5.

This unit is an 8 in., 6 stage motor driven pump designed for parallel operation with the existing pumps. It has a capacity of 700,000 lb. per hr. with a discharge pressure of 1790 lb. per sq. in. and is driven by a 1750 hp., 3600 r.p.m., 2300 v., 3 phase, 60 cycle squirrel cage induction motor. This motor is directly coupled to the pump and is arranged for across the line starting. Pump and motor are mounted on a common bed plate and the unit is located in an extension which was built on the pump bay.

Pump control equipment consists of an excess pressure differential control, actuating an 8 in. regulating valve for maintaining a predetermined constant pressure difference between the boiler feed header and the boiler drums, and a by-pass valve controlled to open when the suction flow drops to 100,000 lb. per hr. in order to prevent damage to the pump and which closes when the suction flow has reached 200,000 lb. per hr. The pump by-pass is discharged to the deaerators.

Boiler water level is controlled by feed water regulators operated by a syphon control actuated from steam flow in conjunction with a water level thermostat. Water level recorders have been installed for each boiler which record the water level within the boiler drum at all times. The drums of boilers Nos. 5 and 6 are 48 in. in diameter while those of boilers Nos. 7 and 8 are 52 in. diameter. It has been decided to install Babcock & Wilcox cyclone baffles in boilers Nos. 5 and 6 due to the smaller drum diameter and also to permit carrying a higher water level without danger of carry-over on sudden changes in load.

In concluding this article it is desirable to again direct attention to the fact that all of the work done in remodeling these boilers and in rearranging the station was done with minimum interference to service. This was possible by working on only one boiler at a time. The problems of placing the new equipment and of strengthening the building structure demanded great care, however, and involved considerably more study than would have been the case if the plant had been built completely new. The accompanying photographs show how well the work was carried out.

List of Principal New Equipment at Edgar Station

Boiler alterations, pulverizer equipment coal and oil burners—Babcock & Wilcox Co.
Cottrell Precipitators—Research Corporation.
Induced Draft Fans—B. F. Sturtevant Co.
Induced Draft Fan Motors—Westinghouse Elec. & Mfg. Co.
Ash and Dust Handling Equipment—United Conveyor Corp.
Combustion Control Equipment—Bailey Meter Co.
Boiler Feed Pump—Worthington Pump & Machinery Corp.
Boiler Feed Pump Motor—General Electric Co.
Boiler Feed Pump Regulating Equipment—Republic Flow Meters Co.
Boiler Water Level Control—Northern Equipment Co.
Desuperheaters for Reheaters—Hagan Corporation.

"Some say we have too much science, too much invention and too much technological progress," said Dr. Charles L. Kettering, president of the General Motors Research Corp., at the United States Patent Law sesquicentennial dinner in Washington on April 10. "It is my contention that we are far behind in our development, for to me research is simply the producing of more jobs, more products and more opportunities.

"We have excess of men, money and materials. What we need is a project, like some of the many that have occupied us in the past. Just one more industry the size of the motor car industry would absorb the greater part of the unemployment. To get new projects we must provide incentive for invention and for the commercial development of new ideas. That is why it is so fitting to pay tribute to our American Patent System.

"There is no department of the government that I believe is serving more effectively the great body of industry than our Patent office. It is not the government's department; it belongs to and serves every American."

Accurate identification of scale by X-ray methods, development of solvents, and controlled treatment by special truck equipment applicable to boilers, internal combustion engine jacks, all forms of heat exchangers and many other types of power and industrial equipment.

Scale Removal By Chemical Means

BY M. E. BRINES
Industrial Chemical Service
Dowell, Inc., Midland, Mich.

BOILER SCALE and its removal has long received the attention of some of the most able engineers and chemists in the world. Much has been written on the mechanism of scale formation and its mechanical removal and the fundamental principles are well understood by the modern operator. By scientific feedwater treatment the amount of scale deposited is materially reduced and in some cases the character of the resulting scale is changed to make it more easily removed, but, due to sudden changes in raw water supply or temporary improper treatment or dosage, the chemical equilibrium within the boiler is often upset resulting in scale formation.

There is considerable controversy on the exact heat loss due to boiler scale for the heat transfer coefficient of a scale depends on the porosity, composition, thickness, and a number of other variables. Scales that are apparently similar in character may vary widely in their insulating effect. This reduction in heat transfer in steam generating equipment results in: (1) a reduction in heat absorption, with an increase in stack temperatures and a decrease in efficiency, and (2) the overheating of the boiler metal with subsequent tube failures which endanger life and property and lead to costly repairs. This is a more vital problem today than ever before, due to the modern trend toward higher pressures and temperatures and increased rates of evaporation.

Excessive wear has been experienced on the piston rings and cylinder walls of internal combustion engines due to abnormally high operating temperatures. This has been traced directly to an insulating layer of scale in the water jackets.

Another serious result of scale accumulation is the reduction of capacity of boilers, auxiliaries and pipe lines. A fairly thin layer of scale can seriously curtail the production of a steam generator. Excessive pressure drops through superheaters, integral economizers, or feed lines due to scale accumulations have resulted in forced boiler shut-downs.

Chemical removal of accumulated scale has many advantages: (1) materially reduces outage; (2) eliminates dismantling operations for solvents can circulate through existing connections and penetrate wherever steam and water flow, cleaning all inaccessible locations, a point of some importance for much equipment is being designed for maximum economy and efficiency rather than accessibility; (3) operating results show that scale deposition is slower on a thoroughly clean metal surface than on one that is

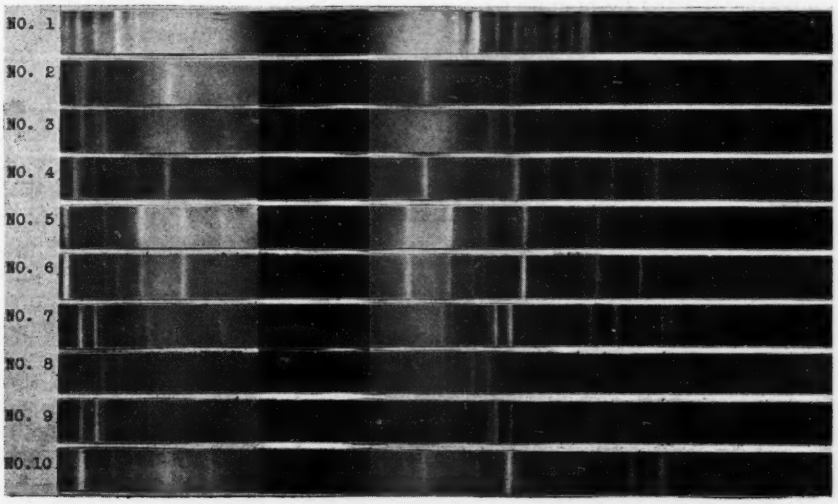


Fig. 1. X-ray powder diffraction patterns of 10 typical boiler scales. The analyses of the scales are given in Table I.

Table I. Analyses resolved from patterns shown by Fig. 1

Sample Number	$CaCO_3$	$Ca_{10}(OH)_2(PO_4)_6$	Fe_3O_4	Fe_2O_3	$Mg(OH)_2$	$Mg_3Si_2O_7.2H_2O$	$CaSO_4$	Misc.
1	100*							
2			30					20% $FeCO_3$
3		40		40		15		5% SiO_2
4								20% FeO
5					60	10	30	
6	25				50		25	
7		20	10	60		10		
8	40	40		10		10		
9		30	5	60		5		
10			60					

*80% Calcite, 20% Aragonite

partially scaled; and (4) actual operation has proved that maintenance has been materially reduced on boilers that have been thoroughly cleaned chemically over a corresponding period after they were manually cleaned.

X-Ray "Thumb-Prints" Scale

In order to develop chemical methods for scale removal the first problem is to obtain definite knowledge of the chemical composition of the scale to be removed. Conventional quantitative analyses are slow, expensive, and while giving almost exact ionic concentrations, the actual combinations of chemical compounds have to be calculated.

The Dow Chemical Co. has made use of the new modern tool of "X-Ray Powder Diffraction"* for chemical analyses of crystalline material. This method is quick, cheap and will give the approximate concentration of the actual chemical compounds present. Scale samples are analyzed by obtaining their X-Ray powder diffraction pattern and resolving the lines of this pattern by comparison with patterns of standard compounds on file. The same crystalline substance always gives the same pattern, each different from that produced from any other crystalline material. The concentration of different crystalline forms of the same chemical compound can be determined by this method. In this way, complex substances which cannot be detected by quantitative chemical analysis can be identified as to composition.

*"Chemical Analysis by X-Ray Diffraction"—J. D. Hanawalt, H. W. Rinn, and L. K. Frevel. Ind. & Eng. Chem. Vol. 10, No. 9, Analytical Edition, Sept. 15, 1938.

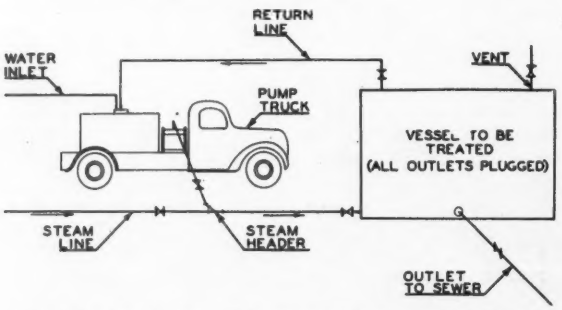


Fig. 2. Treating hookup. The pump truck is a special Industrial Chemical Service treating unit with solvent tank, heater, pumps and hose-reel

Only a few milligrams of scale are required for an analysis. In a heterogeneous scale, samples from parts having different physical appearances can be analyzed separately. A reproduction of the X-Ray powder difraction patterns of 10 typical boiler scales is illustrated in Fig. 1. These patterns have been resolved with standard patterns from the files to obtain the analyses given in Table I. The value of this method depends on the completeness of the reference file of known chemical compounds.*

Selection of Solvents and Auxiliary Chemicals

The usual base for a majority of the industrial solvents used by Dowell Inc. is an inhibited muriatic acid. To this base auxiliary chemicals such as special inhibitors, catalysts, wetting agents, intensifiers, and reaction control agents are added to facilitate results and protect the exposed metal surfaces. Different scales require different inhibitors and auxiliary agents, which account for the importance placed on scale identification. Various metals encountered and

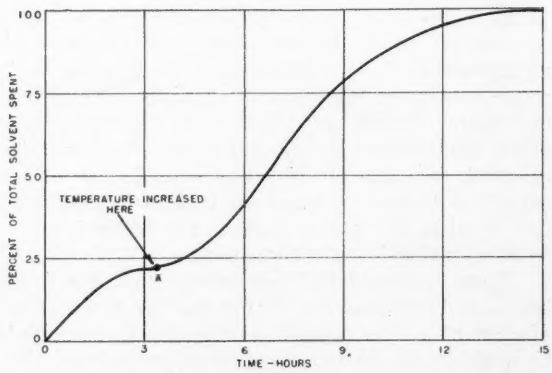


Fig. 3. Typical solvent reaction curve taken during side removal treatment. The temperature of the solvent was 75 deg. F. up to Point A and 150 deg. F. from then to the end of the treatment which is indicated by the flattening out of the curve

treatment conditions also influence the selection of auxiliary chemicals.

Some scales are encountered that require special chlorinated solvents (either liquid or vapor phase) for complete removal, while others require organic solvents. While the same solvent is not effective on all types of scale, certain scales have been encountered for which no satisfactory solvent has been found to date. But if these insoluble constituents are found in relatively low concentrations, the binder can be dissolved, the insoluble portion disintegrated and washed out with water after treatment.

Controlled Application of Solvents

After a careful examination of the sample of scale to be removed, the metals to be encountered, and the design of the unit to be cleaned, the solvent best suited for this particular treatment is determined along with temperature, time and method of circulation.

Materials are transported to location on special designed treating trucks shown diagramatically in Fig. 2. The unit to be cleaned is taken out of service, drained, and isolated from the rest of the plant equipment. As a general rule enough solvent is introduced

Table II. Case histories of representative scale removal treatments

Type of Unit	Condition before Treatment	Condition after Treatment	Remarks
3000 hp. Sterling boiler with integral economizer.	High pressure drop through economizer. Boiler scaled with iron oxides, carbonates, and silica.	Scale completely removed from both units. Economizer pressure drop restored to normal.	Both units cleaned in one operation requiring only 24 hr.
Locomotive boiler	Badly scaled with calcium carbonate, magnesium hydrate, and silica, especially on crown sheet and a mud ring.	Scale completely removed even from stay bolt threads.	Uniformly clean surfaces produced even expansion and eliminated tube rolling when returned to service.
35 hp. Type A boiler.	Scale essentially iron oxide and calcium hydroxy apatite.	Scale dissolved, disintegrated and washed from boiler.	Solvent was in contact with the scale only 3 hr.
100 hp. h.r.t. hotel heating boiler.	Some spaces between tubes completely plugged.	Insurance inspector estimated 99% of scale removed.	The design of this boiler made manual cleaning almost impossible.
Cooling system of 1250 hp. twin tandem compound natural gas engine.	Excessive wear on piston rings and cylinder walls due to abnormally high operating temperatures.	Cylinder water jackets and hollow piston rods descaled.	Operating temperatures returned to normal.
14 in. pipe line approximately 125 ft. long.	1600 g.p.m. flow, 13 lb. pressure drop.	2000 g.p.m. flow, 4 lb. pressure drop.	This line ran from top of cold lime-soda sedimentation tank to sand filters.

through a lower blowdown connection to completely fill the unit at a pre-determined temperature. More solvent is pumped into the bottom and overflowed back to the truck long enough to establish circulation. The solvent is allowed to stand in the unit until reaction is complete. It is then drained, washed, inspected, and prepared to return to service. The time required for complete removal depends on the design of the unit to be treated, the thickness, physical properties, chemical composition, and total amount of scale to be removed. This is often accomplished in a couple of hours but in some cases adapts itself to the schedule better by standing over night.

Fig. 4. This boiler was cleaned chemically up to the top of the manhole. The solvent level is clearly visible with the original scale above the line and thoroughly descaled below the line

In some cases circulation is maintained throughout the treatment. Overflow samples are obtained periodically and checked for solvent strength. A Solvent-Time curve is plotted as illustrated in Fig. 3 and circulation is continued until the curve flattens out. At this point it is certain that all soluble scale is dissolved.

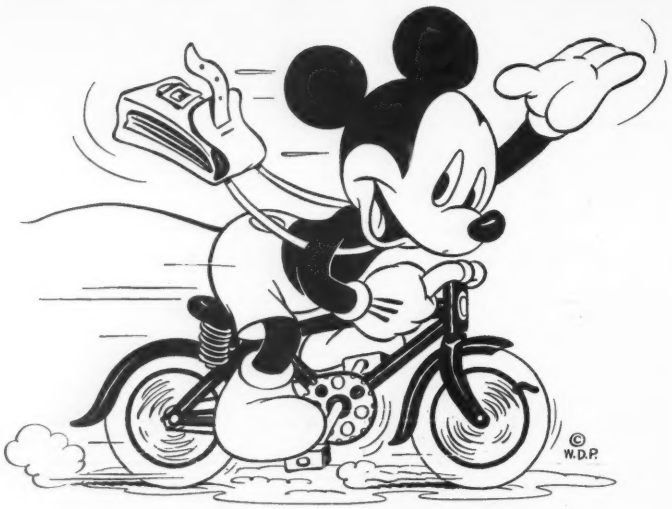
Temperature is a vital factor in chemical scale removal. The curve shown in Fig. 3 was plotted from data obtained on an actual treatment. After two and a half hours of circulation at room temperature the curve started to flatten out. At the point A, steam was admitted to an ejector type heater and the incoming solvent maintained at 150 deg. F. The rate of reaction immediately increased and the treatment proceeded until all scale was dissolved.

An important phase of this service is the "pickling" of new equipment for the removal of scale deposited during fabrication and erection. This descaling can be scheduled just prior to the start of operation assuring maximum production from the very start.

Adaptability to Equipment

This service has a wide application to industry as shown in Table II enumerating typical case histories of successful treatments. Solvents will penetrate anywhere water and steam will flow, making inaccessible places as easy to clean as a boiler drum. The following pieces of equipment have been successfully and economically treated: boilers, heat exchangers, economizers, superheaters, water softeners, filters, make-up water evaporators, feed water heaters, hot water lines, sewers, condensers, turbine blades, and the cooling systems on air compressors and internal combustion engines.

Fig. 5. Sections of a boiler tube (left) as received, (middle) mechanically cleaned, (right) chemically cleaned



Power for

"WHAT do you think, Donald," said Mickey Mouse, "Walt's built us a new studio with a power house an' everything."

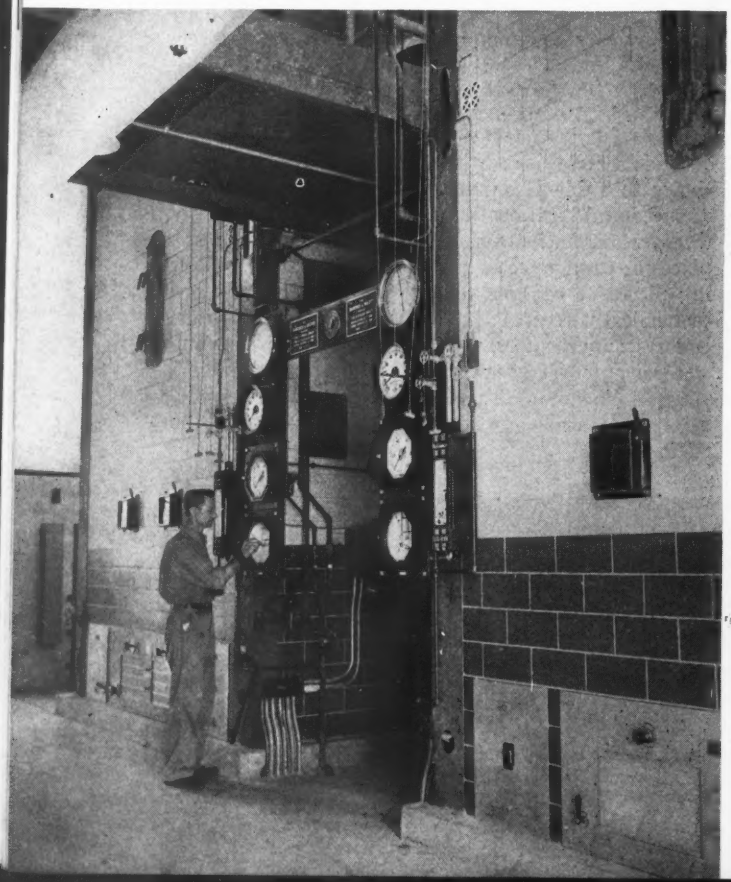
"Quack, quack, quack, who the heck, quack cares," quacked Donald. "It probably only means more work for us, quack, quack, quack!

"Oh, you mustn't feel that way, Don, Walt's really gone to town this time; why, you ought to see the boiler room; it's all white tile and you could eat off the floor, it's so clean."

"Quack, quack, quack, who the heck wants to eat off the floor. Not me, quack, quack. Let that new guy Pinocchio or his bosom pal Jiminny Cricket eat off the floor. We'll be lucky if we eat at all now that this new plant has to be paid for, quack, quack."

It would be unwise, considering limitations in space to follow this discussion between Mickey and Donald much farther but Mickey is right, Walt did go to town in building the Walt Disney Studio. Located at Burbank, Calif., on a 51-acre tract and consisting of 21 buildings with paved streets, fire department, power plant, restaurant, hospital and a recreation center, it is a complete city in itself. In one building alone there are some 900 artists who work in rooms with varying exposures, occupancies and internal loads.

Fig 1. The boilers

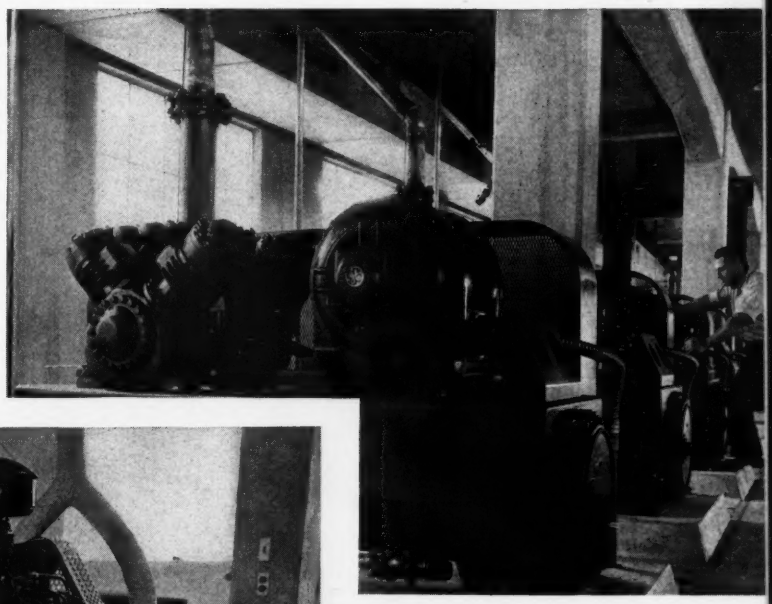


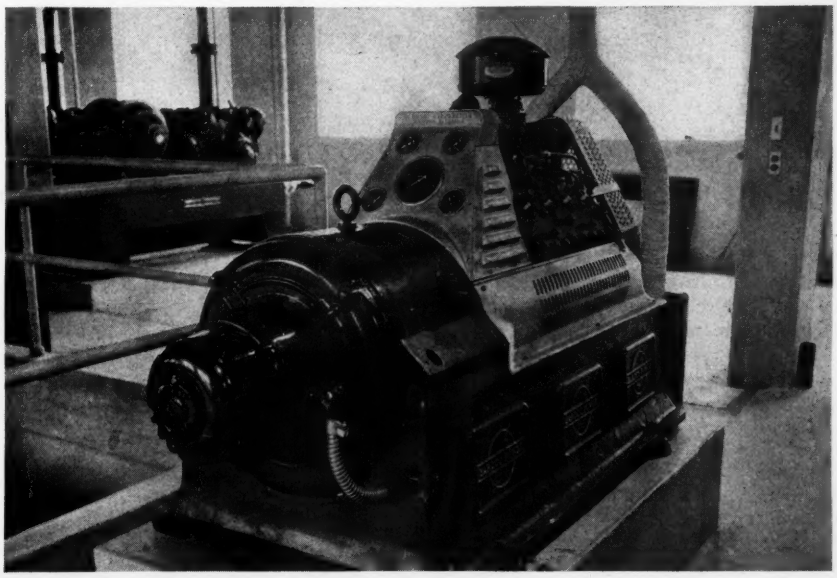
The construction of this studio provided a number of interesting engineering problems. Added to the peculiar problems of sound, illumination and cleanliness which belong to any motion picture studio were those imposed by climatic condi-

Pinocchio

©W.D.P.

Mickey Mouse





No. 2. (Left) The standby generating unit.
No. 3. (Above) The Freon Refrigerating Machines.

tions peculiar to the San Fernando Valley. In the Camera Building the problem was to keep out the dust while at the same time, tremendous heat loads from banked studio lights had to be disposed of without drafts. There were orchestra and dialogue stages where air requirements had to be adjusted to one person or to a hundred with equal facility.

To supply the air conditioning, water, compressed air, and emergency lighting requirements made necessary a fair sized power plant. This consists of a fireproof concrete building 40 ft. wide and 200 ft. long, divided into a transformer room, compressor room and boiler room. The boiler room contains two 3 drum Babcock & Wilcox low pressure boilers, rated at 190 hp. capacity each and operating at about 15 lb. pressure.

Firing is completely automatic, and the units burn either gas or oil. Induced draft is used with smoke stacks that protrude only slightly above the roof. The gas line is provided with an earth-

Fig. 4. The heat exchangers for heating the water used to heat the buildings and the deaerating feed water heater on the mezzanine floor in the boiler room

Jiminy Cricket

©W.D.P.

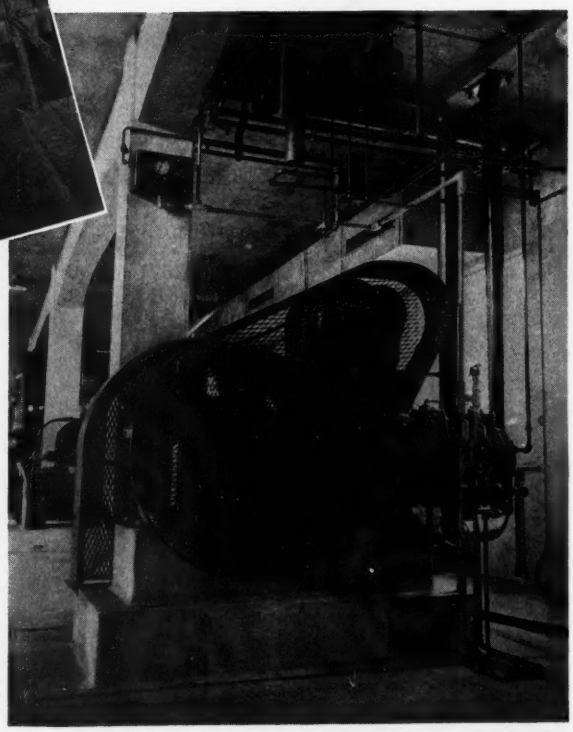


Fig. 5. The 25 hp. air compressor which furnishes air for the artists' air brushes

quake valve which will shut off the gas supply to all buildings if the earthquake obtains a predetermined intensity.

Feedwater, which is well water, is comparatively hard so a Permutit Zeolite softener is installed. An Elliott deaerating feedwater heater insures oxygen-free water for the boilers.

As will be seen in Fig. 1, the boilers are provided with necessary recording and indicating instruments to insure efficient operation. On panels supported by the boiler columns are two Ashcroft steam pressure gages, two Republic steam flow meters, one for each boiler, a third steam flow meter for measuring the steam to the heating system, one Republic flue gas temperature and CO_2 recorder, two Republic draft indicators and two Reliance Eye Hye water level indicators. Copes feedwater level regulators are installed.

The air conditioning requirements are considerable and the refrigerating equipment is an important element in the plant. In the compressor room are installed, twelve 50 hp. General Electric Co. Freon refrigerating machines. The total capacity of these machines is 600 tons but this can be increased to 1000 tons if requirements demand.

A feature of particular interest is the 25 hp. Worthington air compressor in the compressor room which furnishes the studio with compressed air for the air brushes used by the artists. Compressed air is used also to operate the controls on the air conditioning units and for special operations in the Camera Building.

Although the normal supply of electric power for the studio is furnished by the City of Burbank, a 25 kw. Standby Electric Generating Unit has been provided as an emergency power source. This unit shown in Fig. 3 is a gasoline-engine driven unit manufactured by the Barco Co. of Hollywood, Cal.

In terms of power plants the readers of this publication are accustomed to the Disney power plant may not be large but when its purpose is considered it becomes impressive. To Mickey Mouse and Donald Duck it is a huge affair and as Donald Duck implied it represents a large investment. The studio was built with the idea of providing the most modern service to the largest group of artists ever assembled in one spot. It will provide Mickey Mouse and Donald Duck, Pinocchio, Jiminy Cricket, Snow White and the seven dwarfs and all the other quaint and curious little creatures of Disney's make-believe world with a new place, and new ways of amusing young and grown-up children the world over.

Training New Employees

New comers into the family of workers must be made to feel at home in equipment surroundings and among people entirely strange to them. Friendly personal interviews and painstaking instructions aid in reducing beginners' problems.

HERE COMES a stranger in a strange land. How can he be made to feel at home among his fellows and with his work? Obviously by friendliness, interest and assistance. But he must be capable of fitting into surroundings and be adaptable to the job. Hence, the first step is to determine fitness and capabilities.

Interest, abilities and skill of the new comer may be best ascertained by a friendly interview to discuss what he likes to do and what are his ambitions and experience; by simple tests as to manual deftness, which may be casual, such as picking up and orderly rearrangement of spilled articles; and of mental alertness by mental solving of simple problems of procedure and calculation; by trials of skill in doing the kind of work for which he is applying. The spirit of the interview and tests should always be friendly interest in getting the new man successfully started on work he will like. By this method the questions: Will he make good? Will he do? Will he like the work? should be answered, and he can be started with assurance, or given work suited to his abilities and experience. This being determined, "On to the job."

Duties of Instructors

Now comes in the instructor. And he must know how to give the desired instruction as an interested pal. The points to be covered are the how and *why* of organization policies; rules and regulations as to hours, conduct and safety; and established methods of performing operations. Evidently the instructor, preferably the worker's foreman, must know all these thoroughly and with a generous surplus over what he expects to convey to the worker.

Organization policies should cover customs as to employment, promotion, responsibility, welfare work such as insurance, sickness, vacations, emergency aid. And always with illustrations of applications and reasons why those policies have been adopted. Shop rules and regulations should be handled likewise, the object always being to bring the stranger into the family atmosphere as quickly as possible.

With these preliminaries, the new comer may hang up his hat and coat and start to live in the family. His job is before him. What shall he do now? What is the job? How is it done?

Past experience should have developed in the organization satisfactory methods and routine to give the required quality and amount of output at reasonable cost. These should be shown the novice, with their why.

Essentials to Teaching

In his book on How to Instruct (Elliott Service Co., New York City), Glenn Gardiner lists four steps as essential to teaching the job: 1. Tell him. 2. Show him. 3. Test him. 4. Check him.

In the Tell him step are covered the data on materials used, operations to be performed including tools and machine adjustments, results required, precautions necessary to get results and avoid trouble. For winding the field coil of a motor, there would be copper wire or strip, insulation for spool and heads, method of winding the wire snugly and evenly, keeping track of turns wound, care to avoid injury to insulation of wire, making fast the terminals, binding the coil into a firm whole. If the job is complicated, such as lining up an engine, it will be desirable to repeat at least some of the steps, until the initiate comprehends fully. Reasons for all steps should be made clear: Why insulation; the result if wire insulation is injured; effect of loose terminals; result of uneven or bunchy winding; why number of turns must be right. Then have the learner tell *you* the steps, requirements and whys of the job.

Next is the Show him step to illustrate in practice what has been told. Go slowly. It is important that the new worker see clearly each step in the work and be shown why it is done that way. Make sure that he gets it and encourage the asking of questions as to how and why. Good work and accuracy and a satisfactory finished job are to be stressed rather than speed.

Now comes the test of the instructor's work. Have the worker Show you. Watch him as he does the job. Call attention to wrong moves and question him as to why he does things, to make sure that he understands. When he has done a good job, a word of appreciation is not amiss, with the cordial invitation to come to the instructor in case of doubt or problems, and to ask questions about his own work and related operations of others.

From now the worker is on his own but, to preserve the atmosphere of friendly interest, rather frequent visits should be made to check progress and quality of work, and to give opportunity for asking questions or assistance. The need of following instructions and heeding safety precautions may well be emphasized, but encourage suggestions as to better ways of procedure, give them careful consideration and, if not usable, explain why they are not. As the work becomes familiar, the questions of cost reduction and output reasonably expected may be taken up so that the new employe will become established as a regular in the organization.

Spirit of the instruction and instructor are important at all stages. The objects are to give a feeling of working among friends at a worth while job. That cooperation of all is essential to the success of each. That "our" success in doing a good job means success of the organization, which means continuation of the job and pay. That interest and expertness will earn reward as opportunity arises for promotion and better pay.

SULPHUR BURNER Applied To F. W. Treatment

By
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G. A. CAIN and J. B. CHATELAIN
Freeport Sulphur Co.
Freeport, Texas

TO ENGINEERS and chemists thinking in terms of the usual methods of water treating, the applicability of a sulphur burner in this connection may not be immediately obvious. Many of the important water treating chemicals, however, are sulphur compounds. The principal coagulants, for instance, are all sulphates— alum, copperas, and ferric sulphate. Also, in the field of boiler feedwater treatment, sodium sulphite is used for supplementary chemical deaeration, [1,2] and sulphates have been used for many years to establish the proportional concentrations between sodium sulphate and alkalinity which are recommended for prevention of caustic embrittlement*. When the latter purpose is best accomplished by simultaneously lowering the alkalinity, or when it is desirable to lower the pH of the feedwater to protect zeolite minerals or to control the formation of deposits in the feedwater system, either sulphuric acid or an acid sulphate is frequently used.

Sulphur dioxide made from burning sulphur can frequently be used to advantage as a source of the sulphur-containing radical in these water treating chemicals.[3] Mixed with air, it reacts with iron to form either of the iron sulphate coagulants desired. Ferrous sulphate solutions can also be oxidized to ferric sulphate with sulphur dioxide and air.[4] In dilute solution sulphur dioxide can replace sulphuric acid or acid sulphates for neutralizing alkalinity, and it forms the alkaline sulphites useful for deaeration. The production of the treating compound directly in the water to be treated, by adding a solution of sulphur dioxide produced from burning sulphur, also has interesting possibilities for effecting substantial savings in the cost of water treating chemicals. Each of the foregoing processes eliminates from the manufacture of the chemicals the expensive steps of evaporating, drying, bagging and shipping that constitute a substantial portion of the cost.

*A.S.M.E. Boiler Construction Code, "Suggested Rules for Care of Power Boilers."

Practical Application of Sulphur Dioxide to Boiler Feedwater

One of these processes is now employed at the Hoskins Mound Mine of the Freeport Sulphur Co., where it is necessary to add sulphate to the boiler feedwater to adjust the sulphate-alkalinity ratio, and where it is also desirable to use chemical deaeration to completely deaerate the water.

On account of its unique features, a brief description of the whole water treating process may be of interest. Plants furnishing water for the Frasch sulphur mining process compare in size with large steam power stations as users of treated water. In this mining process wells, similar to those used in

SHEPPARD T. POWELL needs no introduction to those familiar with the field of feedwater treatment. He has specialized in this field for many years and is recognized generally as an authority on the subject. In this article he presents a new idea in the science of feedwater treatment, a novel idea which, despite its apparent complications may prove feasible in large plants. We are frank to admit that if any authority less than Sheppard Powell had come forward with this idea we should have hesitated to publish it, but since it is an idea that has been found successful in at least one plant and since Mr. Powell feels that it may be useful in other power plants we are pleased to be able to present it here. It may be applicable only in certain types of plants but this item should be of interest to everybody having anything to do with feedwater treatment. If nothing more it should give one a better idea of the general subject of feedwater treatment.

the production of oil, are drilled into the sulphur formation. Water at 300 deg. F. or higher is forced down into the well and out into the sulphur formations through perforations in the pipe. The melted sulphur is raised to the top of the ground, by means of an air lift, through a smaller pipe concentric with the hot water pipe.

A mine such as the one at Hoskins, Texas, requires 2 to 4 million gallons of treated water a day. From 50 to 75 per cent of this water is designated as "mine" water and is treated to prevent scaling in the pumps and pipe lines when this water is heated to mining temperature (300-370 deg. F.). The other portion of the water is boiler feedwater and must be given additional treatment. The steam produced is used to heat the mine water to mining temperature and to furnish power for operating purposes.

Both the boiler and mine water are treated by a modification of the cold lime-soda process. The unique feature of this process is that no soda ash is added, as such, but is derived from sodium bicarbonate in the raw water. A surface water containing calcium sulphate and a well water containing an excess of sodium bicarbonate are available. These two waters are mixed in the proper proportion to give the desired excess soda ash, and lime is added. After an average of five days retention in the treated water reservoirs, the hardness of the water is 35 to 50 p.p.m. (as $CaCO_3$). The mine water is used without further treatment.

In the secondary cold-process tanks for further softening of the boiler feedwater, originally designed for the use of soda-ash, tri-sodium phosphate is now used as the final softening agent. Phosphate equivalent to the residual hardness is added, and forms a gelatinous precipitate quite unlike the phosphate sludge from hot process phosphate softening. After settling and filtration, the water contains 15 to 20 p.p.m. hardness, sufficient phosphate to remove this hardness in the boilers, and 100 to 125 p.p.m. of alkalinity largely in the form of sodium phosphate and carbonate.

At this point in the treatment, a solution of sulphur dioxide is added to the boiler feedwater, where it neutralizes part of the excess alkalinity to form sodium sulphite. Most of the sodium sulphite is oxidized by the oxygen in the water, forming the sodium sulphate necessary for the sulphate-alkalinity ratio, and at the same time all of the dissolved oxygen is removed from the water.

This process is technically feasible, and with a satisfactory sulphur burner for producing sulphur dioxide there is considerable saving over the cost of sodium sulphate and sodium sulphite.

Development of Sulphur Burning Equipment

To be suitable for this purpose the sulphur burner must operate at rates as low as 1.5 lb. of sulphur per hour and, when set, the rate of burning must remain constant, but it must be possible to vary the burning rate over a wide range by some simple means. The burner must be inexpensive to build and be economical to operate. It should be compact and simple, and require no more attention and operating labor than the usual methods of feeding chemicals. None of the commercial burners available satisfied these requirements, so such a burner was developed. It is essentially a pan type burner with a special sulphur feeding device. It has been found that a burner of this type will burn sulphur at rates as low as 1.5 lb. per hour and that, up to 7 lb. per hr., a definite relation is maintained between the air supplied the burner and the amount of sulphur burned. Larger size burners of the same type operate at rates up to 75 lb. per hr.

The construction of the sulphur feeder is diagrammed in Fig. 1. Solid sulphur is added to the hopper *A* where it is melted by the heat supplied in steam jacket *B*. If a source of steam is not readily available, electric heating elements *C* are provided. Whenever it is desired to fill the feeder *D*, the valve *E* between the burner and feeder is closed and the valve *F* between the feeder and hopper is opened. Molten sulphur runs down from the hopper filling the feeder. Then the valve positions are reversed; valve

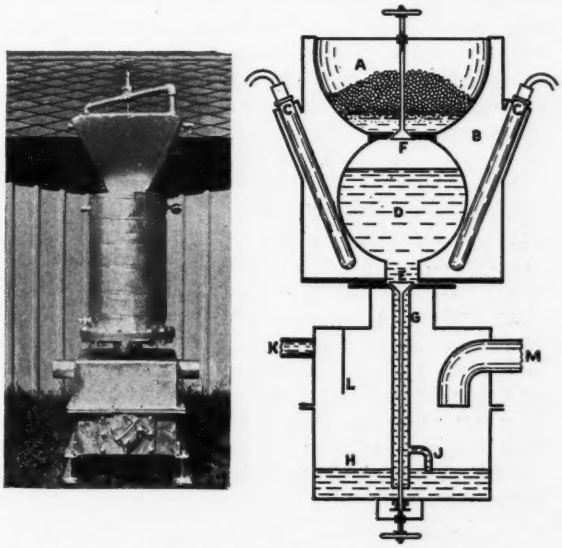

Fig. 1. Photograph and diagram of the sulphur burner

F is closed and valve *E* is opened. Sulphur runs down the feed pipe *G* and until the liquid sulphur level *H* in the burner gets up to the end of small pipe *J*. At this point the flow of sulphur stops, since the end of the feed pipe is sealed and no more sulphur can run into the burner until the level drops enough to permit gas to bubble up the feed pipe and displace sulphur in the feeder until the end of the pipe *J* is again sealed with liquid sulphur. The principle of this feeder is used in a common type of water feeder for chickens. The feeder maintains the level in the burner without any appreciable variation. The particular arrangement with the main feed pipe terminating near the bottom of the burner and a smaller pipe at the surface of the sulphur, is used instead of one large pipe ending at the surface of the sulphur, because it is desired to add the sulphur below the level of the burning sulphur so that the burning surface will not be disturbed. On account of the relative size of the

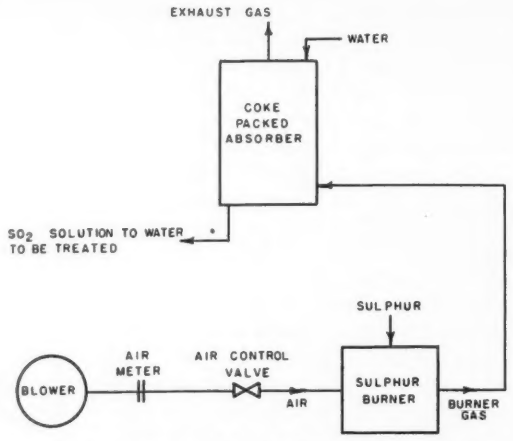

Fig. 2. Flow sheet of sulphur treating system

two pipes all the sulphur goes down the main feed pipe. The feeder is made large enough so that filling is necessary only once a day.

The actual operation of the burner is simple. Air enters at one side *K* and is deflected over the burning surface by a baffle *L*. The burner gas leaves at the opposite side *M*. With the sulphur feeder operating a definite relation is maintained between the amount of air supplied and the amount of sulphur burned.

Figure 2 is a flow sheet of the system that was installed and has operated continuously since March, 1938. It consists of a blower to supply air, an orifice meter to measure the air, an air control valve, a sulphur burner, and an absorber to absorb the sulphur dioxide gas in water. The amount of sulphur burned is controlled by regulating the air supplied to the burner according to the graph shown in Fig. 3. It is feasible to control the air supplied by an automatic controller operated by the volume of water treated. Due to the relatively constant load in this installation manual control is adequate; however, the rate of burning is adjusted, if necessary, once each day.

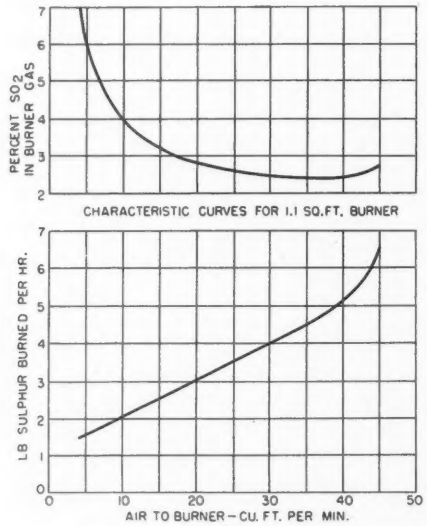

Fig. 3. Graph showing amount of sulphur burned with respect to air used

The sulphur dioxide formed is absorbed in water, and the solution is added to the filtered boiler feedwater, where it reacts and performs the functions described above.

Operation of the Burner

The actual operation of the burner is relatively simple. The filter plant operator fills the hopper with sulphur once a day and sets the air flow at the desired value. The operators record the temperature of the burner gas every two hours, but no other attention is required from one day to the next. The total amount of sulphur fed per day is, of course, readily determinable. Periodically the burning rate is checked by analyzing the burner gas and by calculating, from this analysis and the air flow to the burner, the amount of sulphur burned. This, however, is not necessary since any change from the desired burning rate is indicated by a change in the burner gas temperature.

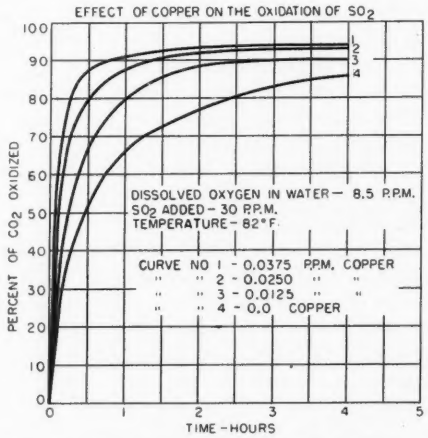
EFFECT OF COPPER ON THE OXIDATION OF SO_2
PERCENT OF CO_2 OXIDIZED
DISSOLVED OXYGEN IN WATER – 8.5 P.P.M.
SO_2 ADDED – 30 P.P.M.
TEMPERATURE – 82° F.
CURVE NO 1 - 0.0375 P.P.M. COPPER
" " 2 - 0.0250 " "
" " 3 - 0.0125 " "
" " 4 - 0.0 COPPER
TIME – HOURS

Fig. 4. Effect of copper on oxidation of sulphur

On account of the small amount of sulphur burned, the heat loss from the pipe between the burner and the absorber is enough so that a gas cooler is not necessary. The sulphur dioxde from the burner is absorbed in water in a lead-lined tower. This tower is packed with two inch coke and water passes downward counter-current to the burner gas. Since filtered boiler feed water from the filter plant wash water system is used for absorption, no extra installation of pumps was necessary. Only a small portion of the water being treated is passed through the absorber.

More than 98 per cent of the sulphur dioxide in the gas is removed in the absorber.

Results of Treatment With Sulphur Dioxide, and the Use of Catalysts

Experience shows that if water having an alkalinity of 105 p.p.m. is treated with 16 p.p.m. of sulphur dioxide, the alkalinity will be reduced to 80 p.p.m. and the sulphate, formed from the sulphur dioxide together with the small amount of sulphate already present, will give a sulphate-alkalinity ratio

of 1.5. The pH of the water is reduced from 10.7 to 10.4. Since the maximum that the burning rate varies from the desired rate is ten per cent and since over four times the desired burning rate is necessary before the boiler water would become acid, there is no danger of this occurring.

As a result of the softened feedwater being saturated with dissolved oxygen, a sufficient quantity of air is present to oxidize the amount of sulphur dioxide usually added. In the pipe lines and flumes between the point of addition of sulphur dioxide and the boilers, the boiler feedwater is retained an average of thirty minutes. Under prevailing temperature and other conditions this is not sufficient time for the oxidation to go to completion. Several catalysts, [5,6] such as iron, manganese, and copper salts, have been found to promote the speed of this oxidation. Copper sulphate is now being used. The accompanying table shows the extent of oxidation at various points, operating with and without copper sulphate. The average time required for the water to flow from the point of addition of sulphur dioxide to the various points sampled is indicated in the column headed "Elapsed Time."

Oxidation at Various Points with and without Copper Sulphate

		No Copper Sulphate		0.025 PPM Copper	
	Elapsed Time Minutes	PPM SO_2	% Oxidized	PPM SO_2	% Oxidized
Sulphur dioxide added	0	28.0	0	37.0	0
Water in flume at filter plant	5	24.0	15	12.0	68
Water in flume outside plant	18	20.7	26	8.3	78
Boiler feed line*	33	19.0	32	7.0	81
Boiler blowdown	—	66	—	20	—

*Corrected for 15 per cent dilution in boiler feed heater due to steam used.

The usual operating procedure is to add slightly more sulphur dioxide than is required to give the proper sulphate-alkalinity ratio. The amount of catalyst used depends largely on the temperature of the water leaving the softening plant; sufficient copper sulphate is added, so that all the sulphur dioxide except the slight excess is oxidized by the time the water leaves the boiler feed heaters. These boiler feed heaters remove all except a small amount of the oxygen remaining in the water. Consequently, the water going into the boilers contains a trace of dissolved oxygen and sufficient sulphite to remove it. Normally 0.01 to 0.025 p.p.m. copper is used to keep the sulphite content of the boiler blowdown at 10 to 15 p.p.m.

The effect of various amounts of copper on the rate of oxidation of sulphite is shown by Fig. 4. These curves are the results of a series of laboratory tests showing the oxidation of sulphur dioxide in filtered boiler water containing various amounts of copper.

Advantages

In considering the application of sulphur and sulphur dioxide, as herein described, to the general problem of water treatment, there are a number of advantages that can be pointed out. On the basis of the experience at Hoskins Mound, it is estimated that the use of sulphur, instead of sodium sulphate to maintain a sulphate-alkalinity ratio of 1.5, results in a saving of about $5.50 per million gallons of boiler feedwater. There is also a saving in the cost of handling 70 pounds of sulphur instead of 650 pounds of sodium sulphate, which more than offsets the cost of power to operate the sulphur burner. The concurrent deaeration of the boiler feedwater also eliminates the necessity of using about 40 pounds of sodium sulphite costing about $1.50.

An additional advantage of using sulphur dioxide instead of sodium sulphate and sodium sulphite is that there is practically no increase in the amount of dissolved solids in the water.[7] This is particularly important in the operation of high pressure boilers. When sulphur dioxide is used, there is practically no increase in the dissolved solids since each molecule of sulphur dioxide added liberates a molecule of carbon dioxide. On the other hand, the use of sodium sulphate in this particular case added 650 lb. of dissolved solids to each million gallons of water.

An unexpected benefit of the treatment at Hoskins Mound has been that the reduction in the pH of the water by the addition of sulphur dioxide has reduced the troublesome deposits in the feed lines.

Biography

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[2]"Chemical Deaeration of Boiler Feed Water," S. T. Powell, Power, *79*, 304-6 and 362-3.

[3]"Recent Trends in Water Treatment," S. T. Powell, Lewis V. Carpenter, L. R. Setter and J. J. Coates, Chem. & Met. Eng., *46*, 481-4.

[4]"Development of Some Fundamentals in the Ferric Sulphate-Sulphuric Acid Process," F. S. Wartman and H. E. Keyes, R. I. 2839, Dept. of Comm., U. S. Bureau of Mines.

[5]"Unusual Boiler Problems Caused by Corrosion," C. Wm. Rice, Combustion 8-2, p. 31.

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[7]"Boiler Reactions at High Temperature," Denham and Bartow, Ind. & Eng. Chem. *22*, 36.

Silver in Steel

Stainless steel, or nickel steel alloy, has been widely used, but has had a tendency to pitting in microscopic holes, which deepen when subject to corrosive action, especially with brine. Comes silver as the remedy. After 3½ yr. of research at Massachusetts Inst. of Technology, under sponsorship of The Chemical Foundation, Edward J. Muhs, Secretary, announces the results.

As small as ¼ of 1 per cent of silver, added in the alloy as nickel-silver, increases resistance to pitting, improves machinability, lessens hardening under drawing and spinning processes, increases thermal conductivity by some 25 per cent and gives better surface polish. Care is needed in producing the alloy but, once formed, it is quite stable and may be remelted and poured, without material change.

Applications in the marine and refrigerating fields where brine is encountered are obvious. Castings, sheets and rods are readily produced.

Application of Circuit Breakers

BY CHARLES P. WEST

Switchgear Engineer
Westinghouse Electric & Mfg. Co.

MUCH has been written about low voltage circuit breakers and their application. The last year has seen the advent of several new designs and the influence of their new features on breaker applications merits discussion. Industries such as Central Stations, Steel Mills, Rayon Plants and Paper Mills have many situations where the value of lost production arising from an interruption of power is very great. Breakers selected for these circuits must be the best that are available. In the past, a circuit breaker was chosen only for the system voltage, the circuit load and its ability to interrupt the short circuit currents to which it might be subjected. These three basic requirements will always dominate the selection of a breaker. However, the applications for modern systems require consideration of other factors which are approaching the importance of the three fundamentals.

It is obvious that a breaker must be rated for the voltage on which it is used. Likewise, it must be built for the load it is to carry. These two conditions are easily determined. The third is more elusive. Short circuit currents on low voltage systems are not subject to accurate calculation. It is known that the methods followed for higher voltage give values which are from 50 to 100 per cent high. Rigorous calculations taking into account arc resistance, fault resistance and the detailed impedances of the various parts of the circuit do not produce results which are much more dependable than simply taking 60 per cent of the usual calculated value as a basis for breaker selection. This figure is open to dispute but so are the values which would be assigned to arc and fault resistance in a detailed analysis. The actual facts are that results obtained on the 60 per cent assumption have proven satisfactory in service. Figures on this basis do not burden the user with an unnecessarily large and expensive breaker and do give adequate interrupting capacity.

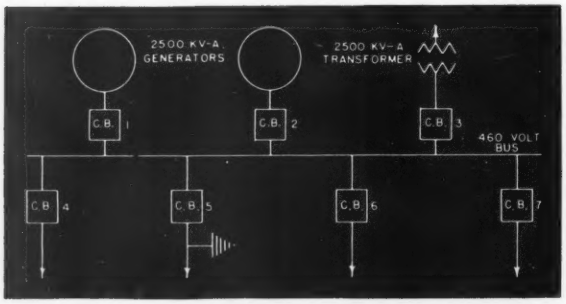


Fig. 1—Typical low voltage system for industrial plant

Engineers who commonly apply high voltage oil breakers often are not aware of the limitations in low voltage air breaker design which conflict with the duty cycles and short time ratings with which they are familiar. A low voltage (600 volts or less) air breaker rating is based on an "O" cycle plus a "CO" cycle with a 2 minute interval and with instantaneous trip. The main contacts may not be tightly sealed on "CO" interrupting cycles and the duty imposed on them is much more severe if tripping is delayed. It also is not economically possible, for instance, to give 2000 amp. breakers five second ratings equal to their maximum interrupting ability which may be as high as 80,000 amp. These two conditions have made necessary the recently adapted NEMA standard requiring that all air breakers have an instantaneous trip set for 10 or 15 times normal current in addition to any time delay trip system which they may have. This standard follows:

STANDARD SG7-26—INTERRUPTING RATINGS OF CIRCUIT BREAKERS (ADDITION)

All air circuit breakers shall be inherently instantaneous in operation (that is, tripping operation) at current values in excess of the following:

(a) 2,000 amperes and below...15 times rated current of the breaker.

(b) Above 2,000 amperes.....10 times rated current of the breaker, but not exceeding 75% of the interrupting rating.

Adopted Standard 9-28-1938

Low voltage air breakers are designed to withstand the mechanical forces arising from the currents published as their instantaneous or monetary rating. This is also the same as their interrupting rating. Fault currents are often displaced and the assymmetrical rather than the symmetrical values must be used. They can be assumed as 70 per cent greater than the symmetrical currents which are obtained from calculations. This means, on many applications, that a larger breaker is necessary than would be selected on the basis of these calculated fault currents only.

For Low Voltage A. C. Systems

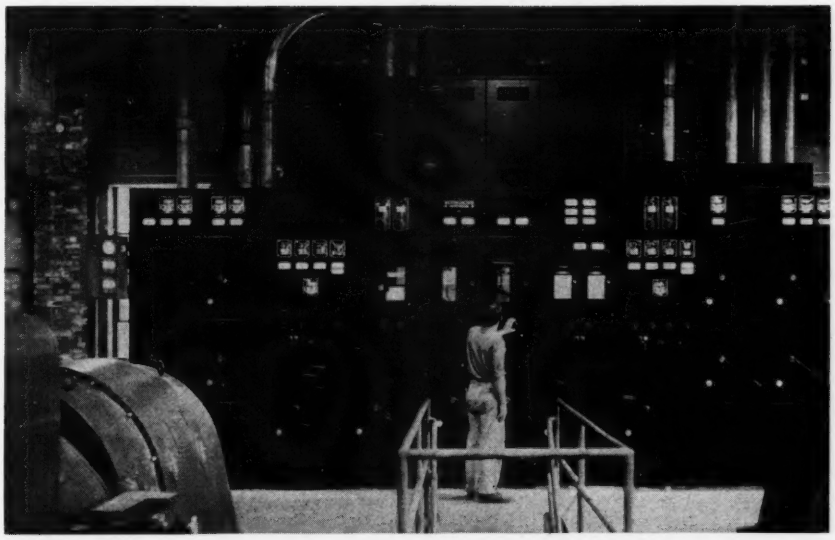


Fig. 2—The 440-v. metal-enclosed switchgear for the power house of Kearney, N. J., plant of the Congoleum-Nairn, Inc., is typical of modern industrial installations

Despite these apparent limitations, low voltage air breakers have been giving generally satisfactory performance and the new designs are meeting operating conditions even better than the breakers built prior to 1938. One thing that has helped the situation is that the estimated fault currents are actually never realized on most systems. Feeder faults are almost always low enough so that selectivity can be obtained between feeder and main breakers by "time of trip" discrimination even with the high current built in instantaneous trip. This is true because the generators cannot deliver currents as high as ten times the rating of their breakers which, therefore, do not open. A typical example of a low voltage system for an industrial plant is shown in Fig. 1.

The equivalent consists of 2—2500 kv-a. generators and 1—2500 kv-a. transformer. Generator 10 per cent reactance, transformer and line 10 per cent. 4000 amp. generator breakers. 1600 amp. feeder breakers.

Consider a fault near the bus on feeder five. The current drawn from the machines or transformer cannot exceed 10 times their rating and, therefore, instantaneous trips on the breakers set for 10 times normal breaker rating will not open these breakers. Therefore, normal time delay trips on the large breakers and instantaneous or short time trips on the feeders give selective clearing of feeder faults. This action is not interfered with by the additional ten times normal instantaneous trips on the large supply breakers. If serious trouble occurs in a generator, its breaker will trip instantaneously and the other feeds to the bus will not be interrupted. Thus generator relaying also functions normally.

The features involved in the application of breakers in addition to the fundamentals of voltage class, continuous current rating and interrupting ability will now be considered. Low voltage air breakers now are frequently supplied in metal enclosed switchgear as has been common for years with high voltage circuits. This means that since these structures are built by the breaker manufacturer, the application of the breaker reuires the determination of the type of mounting. The three common arrangements are the live front board, the dead front board with the breakers behind steel panels or doors and low voltage metal enclosed switchgear where the breakers are on trucks in cells and can be readily withdrawn for maintenance or repair and another unit substituted. The first type is gradually going out of use. It does not comply with strict safety codes and cannot be maintained without hazards to workman and service. On large systems with high fault currents, such breakers are actually dangerous in any location to which untrained personnel is admitted.

The dead front steel switchboard does not have these limitations and is the ideal arrangement for loads of average importance. This construction is well suited to locations where taking a breaker out of service does not interrupt valuable production, keep large and important machines idle or cut off any continuous essential service. Applications of this type are office buildings, schools, small factories or any load which can be interrupted at nights, week ends or other odd times to allow inspection, maintenance or occasional repair. Such dead front boards are usually factory assembled and tested. They are safe, present a good appearance and can be installed at reasonable cost.

The breakers for these boards should, of course, meet the three fundamentals of breaker application. In addition, they should have (1) some modern form of arc interrupting device, (2) have solid silver (or silver alloy) main contacts and (3) be compact in design. Old designs of air breakers simply drew the arc out on carbon arcing tips so

that the upward air draft and magnetic effect extended it until interruption occurred. The time of arcing was relatively long and the damage to contacts and at the point of fault sometimes quite considerable. Wide pole separation and high clearance above the breaker was necessary to prevent flash over between poles. Enclosing structures were necessarily large. A modern breaker has arc extinguishing or interrupting means which clear high current faults in as short a time as two cycles. Contact erosion is much less. Damage at the point of fault is reduced. Gas pressures are not so high. Electrical clearances in cells can be lower. This means small housings and less space required in buildings.

Solid copper high pressure contacts faced with silver or silver alloys are used in modern breakers in place of a laminated brush. Reversed laminated brushes have the desirable feature of increasing their

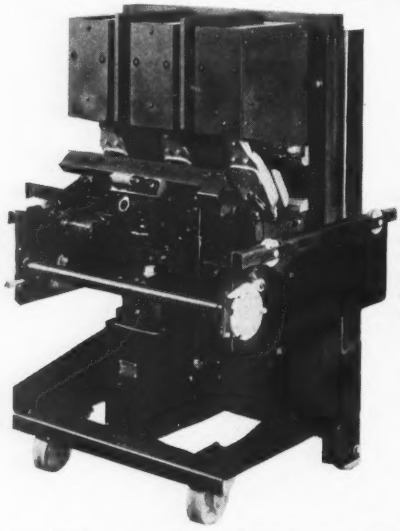


Fig. 3—An electrically operated 2000-amp. 600-v. draw out unit supplied in the Congoleum - Nairn Company's structure for the generator circuits

contact pressure as the current through them rises. This is a great help in carrying very high current for short intervals prior to interrupting a fault. The use of such a design in breakers having extremely high interrupting ability is justified. However, the usual bow shaped laminated bridge brush was one of the weakest features in low voltage air breaker design. It was easily damaged by heating from even small overloads. Over long periods, there was a tendency for these brushes to lose their spring tension and current carrying ability. While silver plating helped the situation, the solid silver contact is much superior to a laminated brush whose contact pressure is reduced by short circuit current. Industrial control devices have always used solid contacts and allowed 65 deg. per cent temperature rise. These are satisfactory because at least occasional operations occurred which had a cleaning action. Air breakers with solid copper to copper faces did not give satisfactory service because they often were closed for long periods and slow oxidation and heating resulted. Solid silver plated contacts have been used for years in network protectors with entire satisfaction. Similar construction in breakers is a natural development.

Laminated copper brush breakers were usually held to 20 deg. rise on applications where trouble free performance and low maintenance was essential. When silver plating became standards, 30 deg. rise was almost universally accepted. However, it was fully realized that small overloads causing overheating might result in serious and permanent injury to a laminated brush. The solid copper silver (or silver alloy) faced contacts are designed for 30 deg. rise. However, they can safely stand a higher rise without damage over 55 deg. average surrounding air temperature allowed in enclosures. It is not suggested that the 30 deg. rise be changed, but it should be realized that this is a conservating rating. Obviously, such breakers will give excellent service at their normal rating and 30 deg. rise.

The N. E. M. A. has recently changed its standards to allow operation of equipment in enclosures at 30 deg. rise above the surrounding air which in turn is allowed to rise 15 deg. above an outside ambient temperature of 40 deg. The gradual improvements in apparatus such as the use of silver contacts in breakers and silver plating of bus joints have made these higher temperatures permissible. This, in turn, makes smaller enclosures possible with consequent saving in building and equipment cost.

The third requirement in a modern breaker is compactness. This means that the manufacturer must take full advantage of scientific arc interruption and more efficient current carrying parts to reduce the size of the breaker to a minimum. Only by doing this can breaker structures be kept small so as to occupy the least possible space in a user's plant.

A special moulded case type of air breaker has been available for several years. It has ratings up to 600 amp. at 600 v., a-c. and 20,000 amp. interrupting capacity. Such a breaker can be safely connected to a bus fed by a 2000 kv-a. transformer bank. Manual and electric operation are available in both fixed and withdrawal type mountings. Thermal and magnetic trips are provided and the usual standard attachments and auxiliary switches. These breakers have proved themselves in service. They have the greatest interrupting ability for their size of any circuit breaker ever built. Their chief advantages over other types are size, fast interruption, and an insulating case so that no live parts are exposed on the front of the unit. A fixed mounted breaker can be quickly removed from the front as it detaches from its studs leaving them and the bus copper and cables in position. This is a great advantage as the connections can be made without having to provide accessibility to rear of the breaker.

Many low voltage circuits supply power to manufacturing processes which are continuous and any interruption means the loss of valuable production. Such conditions exist in paper mills, rayon spinning plants, glass plants, steel mills or any process which operates 24 hours a day and seven days a week. Other circuits such as central station auxiliaries are parts of a large production unit where continuity of service is essential. These circuits should be supplied by withdrawal type units such as are provided

in low voltage metal enclosed switchgear. A spare unit can be provided and substituted for one in service in from one to two minutes. The value of this measured in output of the product being manufactured easily justifies the additional expense of drawout construction. In many cases, the ability to quickly change a breaker has eliminated the need for duplication of circuits to the same loads. In other applications a quickly interchangeable unit can take the place of a fixed mounted dead front breaker with isolating and bypass switches providing almost equivalent continuity of power at no additional expense.

Another factor making low voltage metal clad switchgear desirable is the ability to interchange units and thus carry on maintenance and inspection during normal working hours. This reduces the need for overtime and extra shifts which are becoming more expensive as new legislation limits working hours and increases overtime compensation.

Low voltage metal enclosed switchgear provides the utmost in safety to maintenance personnel because the breakers are disconnected from all circuits and no live parts are accessible. If much work is required, they can be completely removed from the structure. Complete safety interlocking is provided in the withdrawal design for both the moulded case type and open frame breakers. They cannot be pushed into or withdrawn from engagement with the power circuits if the breaker contacts are closed. Mechanical position indicators are provided on these

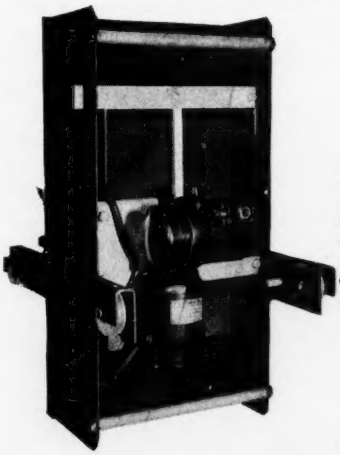


Fig. 4—A rigidly mounted, moulded case, 600 amp. breaker showing how it can be removed from the front of the switchboard without disturbing the connected copper. Speeds installation and reduces maintenance

units. Test positions are provided so that all closing, tripping and auxiliary circuits can be checked with the power circuit open. The moulded case breakers can be left in their cells with the door closed in either the completely disconnected or test positions as well as the normal operating position.

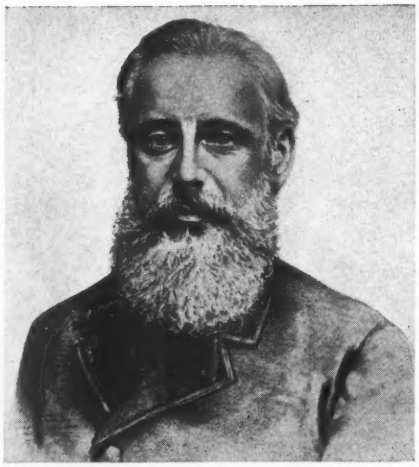
The size of a breaker unit in a low voltage metal clad structure is slightly larger than required for the equivalent breaker on a fixed mounting. Actually, however, the structure is usually smaller because fewer disconnecting switches are used. Manufacturers will ship these structures in as large units as the purchaser can handle. It is advisable to provide doors and hatchways to take care of sec-

Fig. 5—Illustrating the compactness of a draw out unit with electrically operated moulded case breaker for three phase, 600-v., 600-amp. metal enclosed switchgear

tions at least ten feet long, eight feet high and six feet deep. These figures should, of course, be considered as approximate and the openings determined by the actual requirements on the job.

Relays, instruments and watthour meters are usually required on low voltage metal enclosed switchgear. It is definitely undesirable to mount these on the doors of breaker compartments. The terminals and small wiring are exposed in the cells where arc interruption takes place and while they can be protected, a clumsy and undesirable structure results. Two horizontal rows of insruments having scales approximately 5 in. long can be easily seen above a 90 in. high structure. Compartment for fuses, potential transformers or other devices can have a door carrying instruments or relays. These devices can also be mounted on sections provided specifically for this purpose. This arrangement is recommended particularly if space must be provided for the relatively large number of devices required for generator control.

It is evident that the application of low voltage air circuit breakers has two chief factors, the choice of the breaker and the choice of the structure for it. Each influences the other. The basic factors of breaker selection and the desirable features of modern design must be considered. The type of structure should be determined by the service conditions with particular attention to safety, low maintenance cost and the actual value of lost production arising from any cause associated with the breakers and their housing. The proper balance of these various conditions as they apply to a low voltage power system will result in switchgear which is electrically and economically right. Only this can be satisfactory to the owners, manufacturers and the engineers who must mutually solve these problems.



Henry R. Worthington at the age of 48 years

Worthington Centennial

America's water boy is one hundred years old. Honor is due him from industry for his contributions of ideas that have been worked into the daily convenience enjoyed by modern society.

WHEN IN 1840 Henry R. Worthington invented the first direct-acting steam pump, the most optimistic industrialist could not have foreseen the gigantic proportions to which the development of this new device would lead the pumping industry during the hundred years since that time. Nor would anybody have dared to predict a future for the infant manufacturing company started in 1845, as a result of this invention, in any way comparable to what has actually taken place over the span of the century. It would have been entirely too preposterous. For today, Worthington and Water Works have become almost synonymous terms in the vocabulary of industrial men.

This direct-acting pump was not what may be called a chance invention but grew out of a real need—a problem was presented and Worthington came forth with a solution. It took demonstrations and salesmanship to get his ideas accepted by industry, but with proven success and business integrity the reputation of this manufacturing company grew and the number of its products expanded until today it touches nearly every industry and its activities reach all continents of the earth.

Henry Rossiter Worthington, born in 1817, was a direct descendant of Sir Nicholas Worthington of Worthington, England, who fell fighting for the cause of Charles 1st, following which the family left England for America in 1649. Henry's father was Asa Worthington, an engineer and owner of a flour mill in New York city. The inventive genius of Henry was manifest early in life and, stimulated by the desire of the State of New York to further the development of rapid, economical transportation by means of steam boats on the Erie Canal, he designed and built a complete boat. Many problems presented themselves during the design of this boat but one of the most vexing was that of finding a satisfactory feed pump for the boat's boiler. Current practice was to feed boilers by pumps connected directly to the main engine shaft. This necessitated hand feeding when the main engine was not in motion. The direct-acting pump idea grew out of this need. The boat was in use several years and was an entire success from a technological standpoint but met the opposition of boatmen, farmers, hostlers and many others who used the canal, so the legislature complimented Worthington, voted him a medal, and then directed him to give up any further activities with his canal boat. The pump, however, was removed and used for other purposes for more than thirty years.

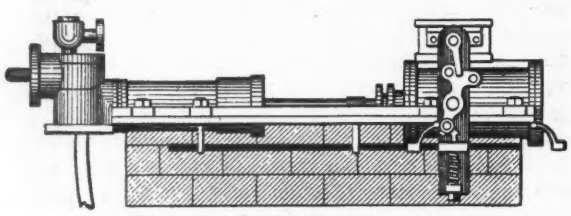


Fig. 1. First direct-acting steam pump

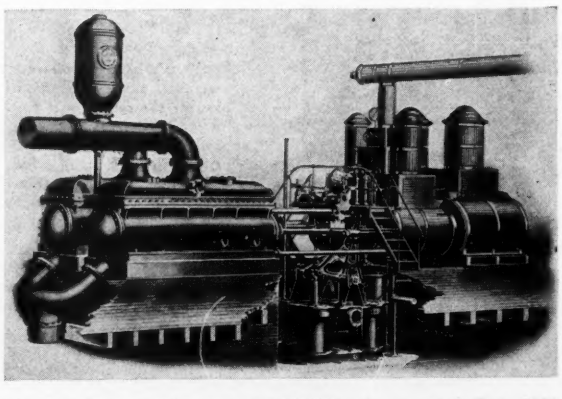


Fig. 2. Duplex pumping unit of 5,000,000 gal. capacity built in 1863 for Charlestown, Mass., the first of similar units installed during the period between 1863 and 1895

Organization Growth

It was not until 1844 that the feed pump idea was patented. Its successful operation gave it commercial possibilities and enabled Worthington to

obtain financial assistance of William R. Baker. Together they started the partnership firm of Worthington and Baker with a small shop in Brooklyn. Baker died in 1853 but it was not until 1862 that the firm name was changed to Henry R. Worthington. Following the death of Worthington, on his sixty-third birthday, December 17, 1880, his son, Charles C. Worthington, took his father's place in the partnership. Associated with him were Dauphine S. Hines, who died in 1886, and William A. Perry. This partnership gave way to a corporation in 1892 when Worthington became sole owner by the purchase of Perry's interests.

From the close of the Civil War to the end of the century, the company experienced a period of great expansion, not only in size and number of products but its activities had reached to many foreign countries. The best road to further expansion seemed to be by way of combinations of companies manufacturing competing and related products, so in 1899 the International Steam Pump Company, Inc., was formed with Charles C. Worthington as the first president. This company was made up of the combined interests of Henry R. Worthington, The Blake & Knowles Steam Pump Works, The Deane Steam Pump Company, the Holly Manufacturing Company, Laidlow-Dunn-Gordon Company, and The Snow Steam Pump Company.

In 1900 Charles C. Worthington retired and was succeeded by John W. Dunn as president, then in 1908 by Benjamin Guggenheim whose death, in the S. S. Titanic disaster in 1912, brought William C. Dickson to the presidency. Following the turn of the century, other companies joined International and added considerable diversity to the products. Among these were: The Clayton Air Compressor Works in 1903; Power and Mining Machinery Company in 1907, but sold in 1924; the International Gas Engine Company was added in 1909, but discontinued in 1924; the Jeanesville Iron Works Company in 1910; and Fred M. Prescott Steam Pump Company in 1910.

Through its program of consolidation and expansion, International Steam Pump Company became so involved financially that in 1914 shortage of working capital caused it to go into voluntary receivership which lasted until 1916 when the company incorporated under its present name, Worthington Pump and Machinery Corporation, C. Philip Coleman occupying the presidency from December, 1917, to July, 1926, when he was succeeded by La Monte J. Belnap and in September, 1931, by Harry C. Beaver, the present head of the corporation.

After the reorganization several other companies have joined activities with the corporation either as part of or in cooperation with it. Among them are: Epping-Carpenter Pump Company in 1919; Platt Iron Works in 1920; Gilman Manufacturing Co. in 1930; Metalweld, Inc., in 1931; Gannon Meter Co. in 1932; Carbondale Machine Company in 1935; and Moore Steam Turbine Corporation in 1937. Through this consolidation of the interests of many smaller manufacturing companies, Worthington now stands in a position to supply industry with an extremely diversified line of products from the heaviest capital goods to many consumer requirements.

Accomplishments

Starting as it did with a small direct-acting pump, Worthington has met the entire pumping demands of industry, municipalities, irrigation and flood control projects, in fact nearly every type of liquid handling problem known to modern civilization. Particularly noteworthy have been Worthington's equipment used by municipalities to furnish water for general use and to remove sewage in projects to improve health.

Savannah, Ga., was the first city to employ Worthington pumps in municipal water works. In 1854 three direct-acting pumping engines, each with a capacity of 300,000 gal. per day were installed in this plant. Among several innovations was provision for completely condensing the steam with the water that was pumped on its way to the service mains. The first compound duplex pumping engine was built for the municipal water works of Charlestown, Mass., in 1863, and it had a capacity of 5,000,000 gal. per day.

These installations were followed by numerous others, many of them containing features of design considered radical at the time of installation. By 1892 the water works pumping engines built by Worthington numbered 1160 and they had been installed in all parts of the United States and Canada. The pumps in use at that time for this purpose were estimated to have a 24-hr. capacity of 2,925,000,000 gal., some individual units having capacities running as high as 15,000,000 gal. per day.

It was not until after the turn of the century that centrifugal pumps began taking a prominent place in water works plants built by Worthington. As late as 1908 Lardner's Point Pumping Station in Philadelphia installed 12 vertical, triple-expansion, flywheel type pumping engines each with a capacity of 20,000,000 gal. per day. In Chicago two record making pumps have been installed. The first

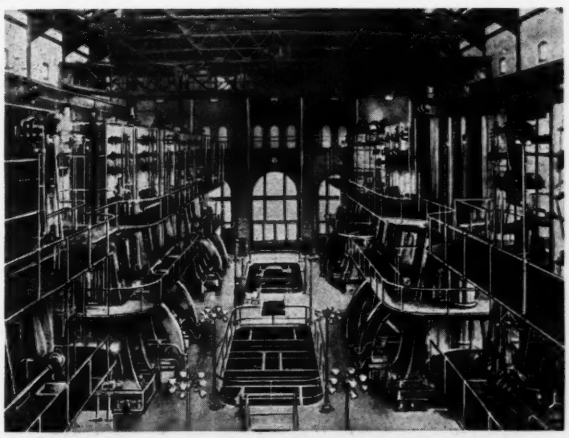


Fig. 3. Lardner's Point pumping plant in Philadelphia built in 1908 was the largest installation of water works pumping engines in the world at that time—12 vertical triple expansion flywheel units each with a capacity of 20,000,000 gal. per day

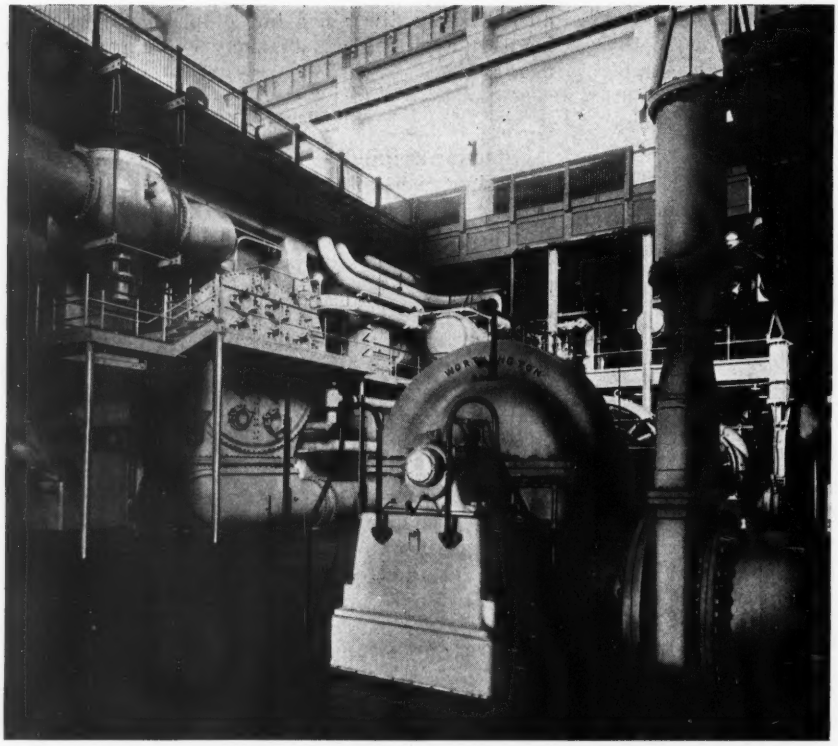


Fig. 5. Installed view of 60,000 sq. ft. surface condenser in utility plant

in 1904 was the largest vertical direct-acting pumping engine ever built; there were two of these, each with a capacity of 40,000,000 gal. per day and measuring 62 ft. from the foundation to the top of the high pressure cylinder. In 1938 Chicago installed a steam turbine-driven centrifugal pump of 80,000,000 gal. per day capacity which again broke the capacity record for this type of service.

Among the more recent services in municipal systems is that of pumping raw sewage in disposal plants. Here again Worthington equipment is prominent. An outstanding modern example is at the Southwest Works of the Chicago Sanitary District where four steam turbine driven centrifugal pumps have been installed, each with a capacity of 193,000,000 gal. per day.

In several of the more modern sewage disposal plants, sludge gas, formerly wasted, is converted into fuel useful in gas engines. Prominent among the Worthington installations employing this system are plants of the Department of Sanitation of the city of New York at Coney Island, and Tallman's Island. In these plants gas engines operated on sewage gas drive important pumps. In a number of other plants throughout the country the engines also furnish electricity for municipal service.

During the past decade, refrigeration and air conditioning have come to be a demanded service in many industries, assembly and amusement halls, hotels, hospitals, office buildings and homes. With a background of equipment for compressing and condensing service, Worthington, through its acquisition of the Carbondale Machine Company, now plays a prominent part in this field, having equipped a number of plants with machinery for maintaining temperatures and humidities most desirable for the service.

It was back in 1854 that Worthington built his first condenser, a water works surface type for the city of Savannah. From this early beginning, the company has been constantly improving and enlarging its surface condensers to meet the needs first for providing vacuum for steam pumps, then for reciprocating engines that required a higher vacuum and now for steam turbines that demand not only high vacuum but units of immense size, such as a 101,000 sq. ft. single-pass condenser serving a 160,000 kw. turbo-generator. Accompanying the development of the condenser design have also come improvements in the auxiliaries. Among these are the employment of separate wet and dry vacuum pumps; multiple-stage centrifugal pumps for condensate removal; counter-current flow of steam and water; steam-jet air ejectors.

It was only a step from condensers to feedwater heaters, for the principles of exchanging heat are not far different in many instances. Impetus along this line was stimulated by the acquisition of the Platt Iron Works Company, owner of the Stilwell heater patterns and patents, and several deaerating type heaters with capacities as high as 750,000 lb. per hr. are now in service.

In 1901, the Snow Works began to build double-acting four-cylinder gas engines used chiefly for driving attached gas compressors but also available for driving electric generators. In the strictly power generating field, since 1902 Worthington has been a manufacturer of Diesel engines with many noteworthy installations to its credit. It was not, however, until 1937 when the Moore Steam Turbine Cor-

poration joined the organization that Worthington has been in position to furnish large steam turbines of its own manufacture. Turbines for all types of service are built in capacities ranging from 25 to 10,000 hp.

Transportation

As previously related, it was Henry R. Worthington's interest in canal transportation that brought about his invention of the direct-acting steam pump one hundred years ago. Steam ships were in the primitive stage. Steam railroads were infants. Other forms of power transportation—automobiles, Diesel driven trains, electric street cars, airplanes—were far in the future. As each of the various modes of transportation put in its appearance and developed into an industry, the contributions of Worthington loomed large and important.

Modern steam ships for ocean service provide nearly all the services available in a first class city, some of them require power equipment with a capacity up to 200,000 hp. Starting with a pump for boiler feed and other general service about the ship, Worthington has kept pace with marine progress throughout its entire century of existence as a manufacturer of modern products useful in marine service.

In 1917 Worthington developed a feedwater heater and pumping system for use on steam locomotives, and it is reported that today more than 6000 locomotives are equipped with such units. The latest of these is of the sectionalized type and consists of a steam-turbine-driven centrifugal pump mounted at the rear of the locomotive, an open type heater set in the smoke box near the stack, and a single horizontal reciprocating hot water pump mounted at the front end of the locomotive.

War Service

It is interesting to note that during the Civil War the White House was supplied with water by means of a Worthington pump as were also a number of Navy vessels. So impressed was Captain John Ericsson, designer of the U. S. S. "Monitor," with the accomplishments of Worthington that in 1880 he wrote: "I regard your pumping engine as the greatest achievement in hydraulic engineering of our time."

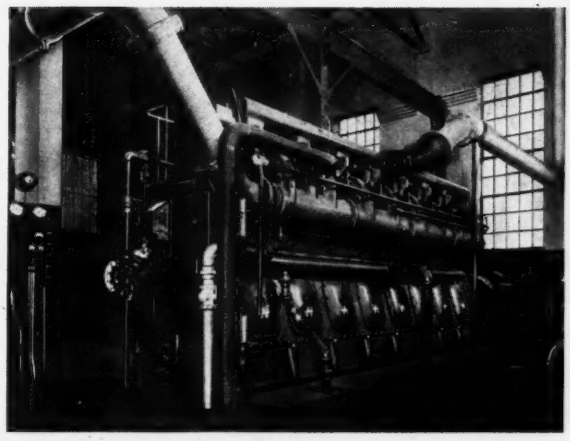


Fig. 6. Convertible gas-Diesel generating unit of 1000 hp. capacity

It was back in 1850 that Worthington began furnishing pumps for the U. S. Navy when two pumps went into the U. S. S. "Susquehannah." This service grew to the point where, during the World War, the Government contracted for 11,000 pumps of all types and sizes to be installed in vessels being built by the Government.

In addition to supplying pumps, pumping engines, air and gas compressors, the various plants of the corporation were extremely active in the manufacture of munitions.

There are few industries in the country that have not in some way or another benefited by the inventive genius, manufacturing ability and business acumen of Henry R. Worthington, his associates and those who have followed him in the perpetuation and extension of the work for which he laid the foundation. Probably the greatest achievement of all has been the benefits cities and communities have derived from the use of healthful water supplies and sanitary sewage disposal systems now available as a result of developments to which Worthington has been a major contributor.

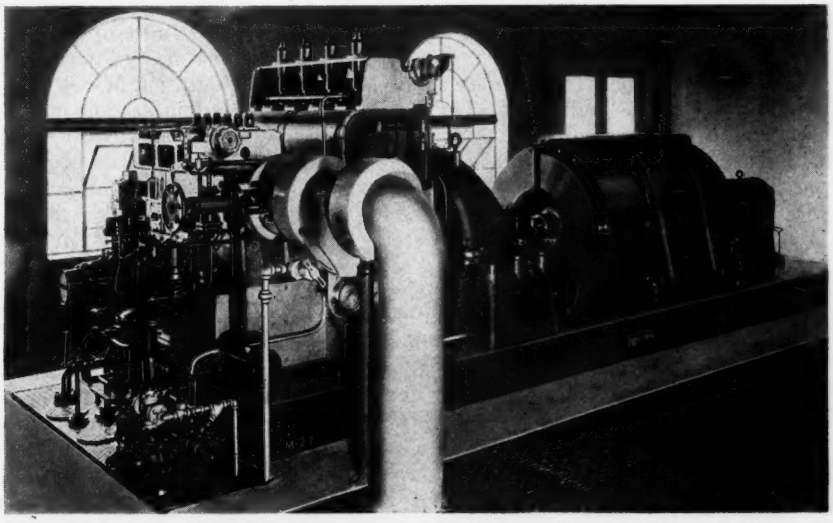
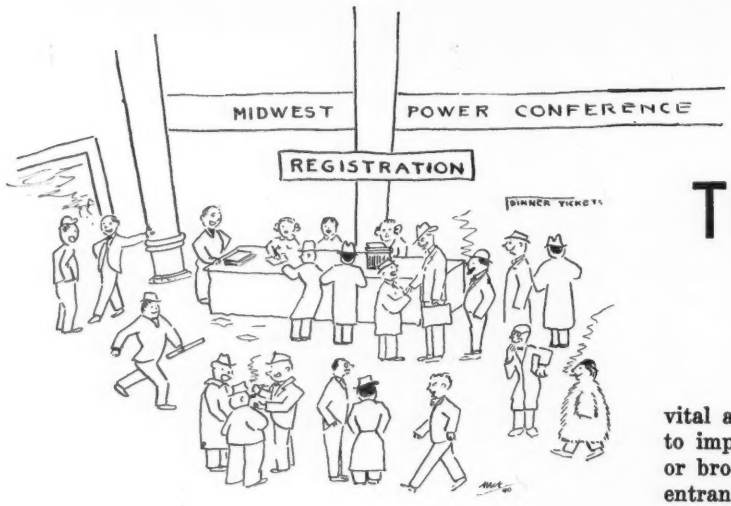


Fig. 6. Bleeder type turbo-generator of 2000 kw. capacity in a municipal utility plant



THE MIDWEST P

THE MIDWEST POWER CONFERENCE which was held at the Palmer House in Chicago, April 9 and 10, was attended by several hundred engineers and students interested in various aspects of power development. In view of the many technical society conventions and industrial conferences of one kind or another, some have questioned whether such conferences as the Midwest Power Conference can be justified, but the fact remains that they are well attended. Attendance at these conferences is free from all restrictions of required membership in technical organizations so they do bring together a group of engineers and students who, otherwise, would not have an opportunity to meet. At these conferences steam, mechanical, electrical, chemical and civil engineers get together and this may assist in bringing about a better understanding of their mutual and respective problems. Especially since 1938 when this conference was reorganized as a cooperative institution with university and technical society sponsorship, there has been more interest in it than was the case when it was promoted as adjunct to a commercial venture.

As its name implies, the conference is essentially a *power* conference and the subject matter of the technical papers presented is primarily concerned with matters of interest to power engineers. At this particular conference an effort was made to discuss the social aspects of power and engineering but as in most instances where people who specialize in one branch of endeavor attempt to discuss matters outside their particular domain, the results were rather ineffective. The average engineer's ideas of the social implications of power are of little more value than those of the average fairly intelligent person of any other calling.

It is admirable, of course, for engineers to want to do something about social conditions and there can be no question in the minds of any intelligent person, engineer or non-engineer, that *power* is a vital and underlying factor in our civilization but to imply that our social problems could be solved or brought much nearer solution by the wholesale entrance of engineers into politics or sociology is something akin to wishful thinking.

Of course the engineer should interest himself in social and political matters; that is his duty as it is the duty of every citizen in a democracy, and because of his analytical aptitude and training the engineer is in a better than average position to evaluate the true basis of social organization. Action in these fields, however, is brought about by political technique, an art in which the average engineer is poorly versed and often constitutionally unfitted for.

In alluding to these matters here, no criticism of the efforts of the conference in this direction is intended. Even engineers can learn a great deal about the social implications of power but it seems to us that at such a conference as this quite as much care should be exercised in attracting the presence of men of outstanding prominence in this field as is exercised in getting the proper men to speak on specialized engineering subjects.

Loran D. Gayton, City Engineer of the city of Chicago, spoke briefly about the social aspects of power at the opening session and both F. Malcolm Farmer and James W. Parker referred to the subject in their addresses at the "All Engineers" dinner on Tuesday evening but in each case only superficially. As National President of the American Institute of Electrical Engineers, Mr. Farmer is naturally interested in promoting a wider social recognition of not only the electrical engineers but all engineers and his remarks to that effect were well put but in the main they concerned matters with which most engineers are already familiar.

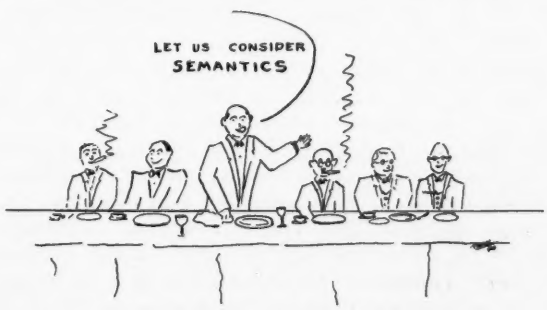
The same may be said of Mr. Parker's address. His specific subject was "The Evolution of the Engineer." Mr. Parker had read Stuart Chase's writings, particularly those dealing with "semantics" and his effort to establish his remarks on a true semantic foundation, though laudable, was only moderately effective. This, however, did not detract from the merit of his discussion of the engineer, and his conclusion regarding the engineer's course of action in matters other than engineering were well expressed. The engineer's work, he pointed out, is largely analytical; it consists in the translation of knowledge possessed only by few into works

T POWER CONFERENCE

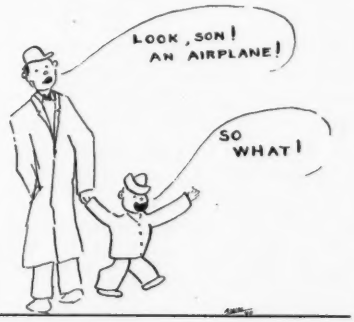
which can be used in the everyday affairs of men. It is not necessary that the public in general understand the processes and devices which the engineer's efforts make available. If it can use them to advantage, that is sufficient.

As Mr. Parker pointed out, the children of today accept without blinking products of engineering research which to their elders are still matters of wonderment. "The youngsters look upon these things as part of the existing conditions of the physical world just as men in ancient times regarded wind and water and fire as the natural phenomena of their world. The capacity of the human mind to adapt itself to new conditions which may be imperfectly understood seems almost unlimited and comprehension of the natural laws involved is not in the least necessary."

It is the engineer's function, however, to understand these laws and direct them. This is a fascinating province of human endeavor and whatever the material incentives, the satisfaction which work in this field brings must always remain the impelling motive behind the engineer's achievements. The satisfaction of accomplishment and of having one's work judged by fellow workers capable of judging has value beyond and above the material rewards. With regard to the professional engineering organizations, Mr. Parker said their most important function is the maintenance of forums for the presentation and discussion of original work, the current printing and cataloging of literature of engineering and the continual amendment and codification of its practices. These, he said, are the real purposes of engineering societies and all their machinery of administration and social contact are but means to that end. While the societies cannot, without shirking, stand aloof from the practical problems of existence, neither can they afford to identify their philosophy with that of other groups whose purposes are essentially akin to their own.



Mr. Parker had read Stuart Chase.



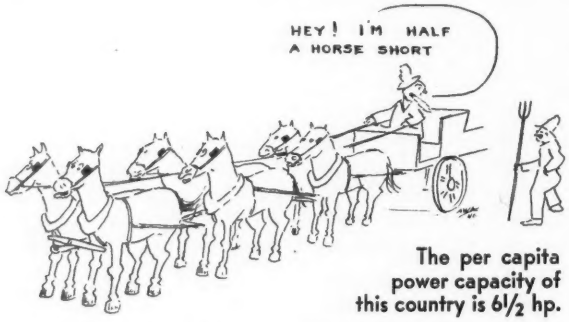
Children of today accept without blinking things which are still matters of wonderment to their elders.

More concrete in his implications than either Mr. Farmer or Mr. Parker was L. W. W. Morrow in his treatment of power in relation to our social structure. Mr. Morrow, who is editorial director of the McGraw-Hill publications in Chicago projected statistical data on power development against the background of our social structure and made an endeavor to interpret the picture as a whole in terms of power. Curiously enough, our power producing capacity in turbo-generators and prime movers in industrial plants and central stations constitutes a relatively small portion of the power producing equipment available in this country. The utilities alone, Mr. Morrow showed, had an installed capacity of some 38,000,000 kw. but by far the largest proportion of the available power at the disposal of the people of this nation is inherent in the 30,000,000 motor vehicles in the country and in the airplanes and railroad locomotives. Altogether the per capita power capacity of this country is about 6½ hp.

This vast amount of available energy in this country has a profound influence upon the lives of its people, far more than the average person realizes. As Mr. Morrow pointed out, we are beginning to regard power as a necessity—a commodity every-

body is entitled to. Because of this tremendous importance of power, it has been popularized and used as a political football.

The importance of power in the lives of our people, Mr. Morrow implied, is reflected in the change in the use of the power output of the utilities. If we study the use of power in this country we find a startling change during the last 20 years. Twenty years ago, about 65 per cent of the utility power went to serve industrial establishments and



The per capita power capacity of this country is 6½ hp.

most of the remainder supplied street railways and lighting circuits. Today 50 per cent of the utility power goes to industry and the remainder goes to serve farms, homes, street lighting and commercial buildings. Today the stable business is residential and commercial and the hazardous business is industrial.

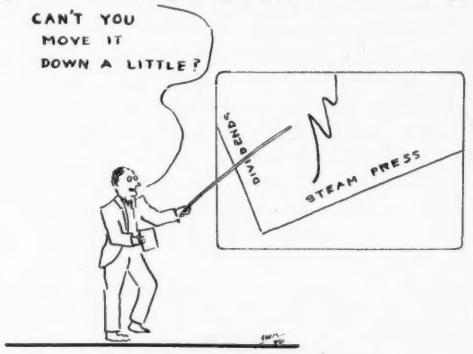
Shifts in power application, said Mr. Morrow, cannot be predicted or controlled. Back in 1925 railroad electrification was looked upon as the most promising prospect for the use of power. We did not foresee that the gasoline engine would minimize this prospective load because of its effect upon transportation. Yet in a few years the internal combustion engine has grown to an installed capacity of 800,000,000 horsepower—ten times that of stationary prime movers. Nor did we anticipate the great increase in the use of power for homes and offices—the type of load that proved the salvation of the utilities during the depression.

With respect to power transmission, Mr. Morrow was of the opinion that the grid idea was inferior to the plan of using many small plants at load centers with energy distributed locally. From the viewpoint of hindsight, the worst economic mistake made by the power industry was to develop hydro power at a distance from the load. Experience has taught power engineers that each hydro kilowatt on most rivers must be backed by a steam kw. As far as the steam turbine as a prime mover is concerned, Mr. Morrow said that nothing now on the horizon threatens its continued use except possibly the development of the gas turbine.

The gas turbine was the subject of a splendid paper presented at the opening session of the conference by Paul R. Sidler, resident engineer of Brown, Boveri and Co. This paper covered the history of gas turbine development, its fundamental technical requirements and its present day status. In view of the comparative rarity of gas turbines in the experience of American engineers, it was quite surprising to learn from Mr. Sidler's paper that since 1923 when the first commercial gas turbine was brought out by Brown-Boveri, over 1000 exhaust gas turbine driven supercharging blowers had been built.

The experience gained in the use and development of these units led to the development of the Velox steam generator some ten years ago which made effective use of the gas turbine. At the present time Mr. Sidler said twelve gas turbine driven compressor sets are in operation in this country, nearly all in the various plants of the Sun Oil Co. and the Socony-Vacuum Oil Co. Delivered with the meticulous preciseness characteristic of the European technically trained man, Mr. Sidler's paper was of decided interest to those who had not followed recent developments in this branch of the art.

Preceding Mr. Sidler's presentation on the Gas Turbine, Philip Swain, editor of Power, presented a short discussion entitled "Power Fallacies." Power fallacies, said Mr. Swain, fall into two groups; first, those involving simple physical misconceptions



Mr. Moe's slides wouldn't fit.

where no commercial or personal interest of the individual or his sources of information enters the picture, and, secondly, those in which widely held mechanical concepts vitally affect public policy and where private interest loses its purely mechanical character. These were the harmful type of fallacies. As an example of the latter is the general belief that the chief cost of delivered electric power is the cost of the coal burned, a fallacy which Mr. Swain believed was largely responsible for the present undue emphasis on hydro power. In presenting these thoughts, his plea was for a more alert and vigorous opposition by the engineering professions to all widely held power fallacies.

Of particular interest to power plant operators was the address by Parker Moe, superintendent of power of the Milwaukee Works of the International Harvester Co. Mr. Moe told how for a period of ten years of continuous operation of his boilers he had maintained an average thermal efficiency of 89.39 per cent with a corresponding stack temperature of 281 deg. F. During that time also there had not been a single shutdown, there had been no replacements of suspended furnace arches or any furnace refractory, nor had there been any tube losses on any boilers, waterwalls or economizers nor had they

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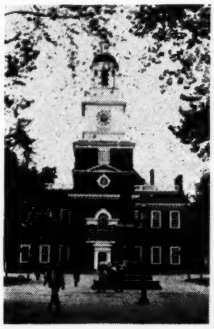
R. H. MORRIS, EDITOR



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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

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Man must profit by his own effort, 'tis true, yet here is a real message for the small plant owner or manager who neglects his maintenance problem because penny savings today shine bright and hide the dollar grief of tomorrow. At the same time there is a world of advice and encouragement to the man seeking opportunities and who is willing to go out and fight his own battles with the knowledge that he prospers in proportion to the service he renders.

The Lord Helps Those—

BY E. L. RICHARDS
General Superintendent
Coyne Electrical School

SEVERAL YEARS ago during the worst period of the depression a well-known engineer and business man said "there is a good job for every unemployed man who has some valuable service to offer to an employer. . . . Service which will evidently net that employer a profit over what he pays the man in salary."

While logical enough such an assertion was difficult to believe at that time, but I have seen the truth of that logic proven out on numerous occasions during the past several years. I have witnessed occasions where plant or equipment owners felt that they could not have certain work done and the applicant for the job accepted that statement much too readily. They failed to get together and both missed an opportunity for profit. I have seen other cases where a competent and aggressive individual convinced the employer that he could save money for him by doing certain needed work at a fair wage, resulting in employment for that person and a definite profit for his employer.

One branch of the electric trade in which many similar opportunities exist throughout the country today is maintenance contracting. Opportunities in this field are almost completely overlooked in many localities—going begging for want of some competent maintenance electrician to capitalize them.

They like it down South

For example, there are thousands of small shops, factories, stores, offices and hotels that really cannot afford to employ a full-time salaried maintenance electrician, because they do not have enough of such work to keep a man busy full time. Nevertheless the electrical equipment in these places needs certain care and repair which is often seriously neglected because its owner puts off until the last possible moment the calling of a service electrician, or sending out of equipment to the repair shop.

The Small Plant

In many such places motors are allowed to run overloaded, at undervoltage or poorly lubricated at the bearings but with oil soaked or dust clogged windings, until they burn out and cause expensive shut downs and delays within a small fraction of what their useful life should be if they were given proper inspection and care. Low power factor accounts for many more burnouts and losses.

Lights are allowed to operate with old inefficient bulbs in which the filament is nearly burned away, the interior of the bulb is coated nearly black, dirty fixtures and reflectors and low voltage, all of which may reduce the efficiency to little more than half of its original value.

In still other cases, wiring has been allowed to deteriorate until the insulation is rotten and leaky, with circuits badly overloaded and sloppy, dangerous, temporary wiring creating fire and shock hazards with continuous losses due to voltage drop and grounds. In the majority of such cases these conditions could be prevented or remedied by a little attention from an intelligent and competent maintenance electrician at much less cost to the owner than he is wasting in excessive power bills, unnecessary shutdowns and expensive repair bills.

If more of the trained and experienced electricians in the neighborhood would offer their services on a part-time basis to several such employers, instead of waiting for a full-time opening in some one concern, many of them would find very profitable employment in a line that can often be built up to a very substantial business. This not only applies to independent individual electricians, but to many of the established electrical service shops and contractors which are not giving these small maintenance jobs the attention they deserve.

However, the independent electrician who can go from plant to plant with a moderate kit of tools, can often provide this preventive maintenance service at lower cost than some of the repair shops, because of his lower overhead. Many equipment owners are quite willing to have modern inspection and maintenance service for their equipment when shown the saving that it can effect, and the small monthly cost at which it can be obtained.

They want to be convinced

If the maintenance contractor has lined up several small plants, some on written contracts and others on verbal agreement during the trial period, some places may require only a few hours of his time each month to inspect, test, and clean a few motors, controls, and lights. Others may require several days per month to properly inspect, test and repair a larger group of machines and lights.

Five or twenty-five dollars per month is not a large amount to pay for this service even though their equipment may not justify a steady electrician at $125 to $200 per month. It does not require many places at $5, $10, $20, or $30, per month to make a nice income for a busy maintenance contractor.

Some equipment owners when offered such a service reply that they can't afford it even at $5.00 per month, as their electrical repair bills have not averaged that amount so far. These men generally overlook the much heavier repair bills they are certain to have a little later when their machines start to burn out and fail in a fraction of their normal life, because of the neglect on repairing small things before they become serious.

Regular inspection, cleaning, insulation testing, bearing lubrication, brush and commutator repairs, etc., can save much of this trouble and prolong the useful life of this equipment many years. If large factories and plants find it profitable to maintain large crews to provide this modern preventative maintenance service, then why can't the smaller shop owner profit by it on a smaller scale?

Case studies

For example, the writer knows of one recent case in which a capable young electrician out looking for a job, offered his services part-time to a plant owner, who had emphatically said he did not need an electrician. Starting out at a few hours per week this man showed such savings and improvements on the electrical equipment he maintained and repaired, that within a few weeks it developed into a full-time maintenance job.

It was found that this plant was having frequent burn-outs of motors due to

Some are from Missouri

overloading, low line voltage, poor power factor, defective controller contacts and protective devices, improper fusing, etc. After a brief study of this condition by the writer, who acted in a consulting capacity to the maintenance electrician, savings were effected in the repair bills and production delays, that far more than paid the electrician's salary.

In another instance an electrician who offered this maintenance service to a small plant owner made a few inspections and minor repairs before he was asked to rewind the armature of a burned-out 5 h.p. d.c. motor. After satisfactorily completing this job at a reasonable cost and a fair profit to himself, he was shown several dozen burned-out machines which had been held in a storeroom unrepaired, because this owner had received exhorbitant estimates on rewinding at outside shops.

In a fairly modern foundry plant the maintenance electrician who got in on the job, noted symptoms of low power factor. As a result of a few days of testing and the rearrangement of certain motors, and, more effective use of several synchronous motors already in the plant, he improved the power factor with an investment of less than $700, to save more than twice that amount annually on the power costs.

In still another quite sizable manufacturing plant where wiring had been added and circuits run without "rhyme or reason" for years, the cables were overheating, motors running slow and hot, lights burning dim and fuses blowing out due to voltage drop, line losses and low power factor.

The maintenance electrician who got in on this job, part-time for inspection and repair, rearranged the wiring, installed a simple feeder net work and greatly reduced line losses without buying any new wire or cable. By shifting some of the induction motor load and use of a few static condensers he improved the power factor considerably. Results, sufficient savings to more than pay his salary.

He now has a steady job in a plant where until recently the owners thought they could not afford a regular electrician. Furthermore, he provided a little more work for the steam men who now have to supply more steam heat to substitute for that part of the heat formerly supplied by electrical losses in the machaines and cables. Improved production due to better running electrical equipment has further advanced the position of this company on the profit side of the ledger.

In the South too

As a final example, a young man of my acquaintance applied for a job in maintenance with a department store in a southern state. When told that they didn't have enough work to employ a steady man, he asked to be given a trial on whatever work of this nature they might have, even if only a few hours per week. He got it, and immediately set out to do the same with several other stores in his town. In less than one year, during the depression he built up his maintenance contracting to a point where he hired a man to help him and branched out into several other nearby towns. He now keeps five men, 2 service trucks and a well-equipped shop busy.

A wide variety of similar opportunities in maintenance contracting are open to those with a thorough knowledge of machinery operation and trouble, modern maintenance methods, the use of simple test instruments, and, the ability to sell this money saving service to plant and equipment owners who have not yet had it properly presented to them.

Much of this maintenance work can be done with only a very moderate investment in tools and test equipment. To be done to the best advantage and profit it requires a thorough knowledge of various types of machines and devices and of modern maintenance methods. Those who will aggressively sell and competently furnish this class of maintenance service can do much to bring a return to prosperity to themselves and to the plants they service.

· · · Shorts · · ·

A white pine splinter shaved in a thin wedge shape makes a convenient temporary repair on bad water or low pressure steam leaks, for it swells when wet. Because it swells quickly it must be driven in fast.

* * *

While ordinary commercial boiler furnaces run from 20,000 to 50,000 B.t.u. per hr. per cu. ft. heat releases of up to 500,000 can be obtained under special conditions. During the development work on the Steamotive with oil fuel the heat release exceeded 400,000 on peaks and ran 375,000 under continuous load.

* * *

It is reported that due to the difficulty of determining, with conventional firing instruments, whether an excess or deficiency of air is being provided with gas fuel combustible gas indicators are being used with some success in midwestern power plants.

* * *

In an Eastern plant bacteria contamination in the service and drinking water system was eventually traced to new cylinder head and valve chamber gaskets coated with graphite and cylinder oil mixture. The oil apparently served as a breeding ground for the bacteria which appeared repeatedly after thorough cleaning of the pump.

* * *

In a western refrigeration plant, 9 yr. old, with two 10 by 10 V.S.A. 2 cyl. compressors driven by 100 hp. motors a saving of 8 per cent in the power bill was made by changing from manual to automatic control and a further saving of 4.8 per cent by adding capacitors to increase the power factor from 76 to 98 per cent. The change paid for itself in 39 months.

* * *

Speaking at the Westinghouse Air Conditioning School, J. Eadie, of Eadie, Freund & Campbell, consulting engineers, said: "Since he is employed by a client for disinterested advice, the architect or engineer may not solicit or accept commissions or discounts from manufacturers or contractors nor incur any obligations which would bias his actions in the service of his client. He should also keep informed on all subjects with which he may be called upon to advise and he will serve his client best if he prepares his specifications in a clear and informative manner, and conducts his work in such a way as to provide a fair deal for contractors and manufacturers. He should also carry this to the point of definitely opposing wilful or misinformed efforts by the client to secure that to which he is not entitled."

Wire Rope Inspection

Part II

By W. Elwood Rossnagel, Safety Engineer
Consolidated Edison Co. of New York, Inc.

EACH OF THE 21 factors enumerated in Part I* should be carefully investigated, and summed up in relation to the "personal and property hazard" and the "original safety factor." Where average initial safety factors have been used, or where the personal and property hazard is great, such as in elevators, mine hoists, machine shop cranes, turbine room cranes, foundry cranes, etc., or where the indeterminate factors such as fatigue and corrosion are evident, a conservative rule should be followed in condemning the rope. The rule of the U. S. Bureau of Wires is recommended for use in this case.

Table I. Condition of rope beyond which it is not safe to use where personal safety is involved

Broken Wires in One Rope Lay		Wear on Outside Wires
None	but	35%
3	or	30%
4	or	20%
5	or	10%
6	and	0%

On the other hand, where high initial safety factors were allowed, and where the personal and property hazard is not great, such as in the case of bucket hoists, skip hoists, unloaders, hand power cranes, derricks, etc., a more liberal rule may be followed in condemning wire rope, such as is given in Table I. The term "total" indicates the total number of wire breaks in all strands in one rope lay. "Adjacent" indicates the number of adjacent wires broken.

On machinery such as horizontal cable roads, drag lines, steam shovels, etc., where no danger will ordinarily result from a cable failure, it is customary to keep the rope in service until an entire strand fails.

Special attention should be paid to the end attachments for the rope, as the rope is no stronger than the attachments. Where clipped eyes are used, see that all Crosby clips are placed so that their U-bolts bear upon the short or dead end of the rope. The clips should be spaced about six rope diameters apart, and no slack should be permitted in the short end of the rope between clips. Where the clips have been improperly placed on the rope, it is necessary to cut off the crushed portion of the rope before reapplying the clips. If the clips used have roddles (the corrugated forged parts) bearing upon both the live and the dead end of the rope, it is immaterial how they are placed on the rope. Also, one less clip is required than is recommended for Crosby clip installations.

The end of the rope should be seized to prevent unlaying of the rope and also to prevent displacement of the strands at the first clip. The inspector should look for loose clips as well as those so tight as to damage the rope.

In cases where left-lay rope is used, make certain that left-lay clips are used, as right-lay clips on a left-lay rope, or vice versa, will cause cutting of the wires in the strands due to the fact that the sharp ridges between the growers in the roddle of the clip run crossways to the strands rather than between and parallel to the strands as intended. Such left-lay clips are obtainable, but are not stocked by all dealers.

A heavy thimble should be used in every eye, whether spliced or clipped, and this thimble should not be deformed, broken or displaced.

Where spliced eyes are used, it should be learned, if possible, if they were made by an able splicer, and it should be noted that at least four tucks have been taken. The projecting strand ends should be covered by a serving tightly wound onto the splice.

Tying of cables, such as in half-stitches or square knots is prohibited. All rope ends should be provided with at least three wire seizings of about ten wraps each, and spaced an inch or so apart to hold the strands in their proper position in the rope.

Where sockets are used, a special inspection should be made of the rope where it enters the throat of the socket. If even a single broken wire is observed, or if corrosion is evident, the end of the rope should be ordered cut off and the rope re-socketed. It should also be noted if the twist in the rope has accumulated near the socket due to continual operation over improper sheaves. In such a case also the rope should be cut off beyond this joint, and resocketed.

All hoisting ropes such as on elevators and mine hoists should be resocketed at frequent intervals, varying from monthly to bi-yearly according to the severity of service. Before resocketing, the socket should be annealed by heating in a wood fire to a cherry red color and then allowing to cool with the ashes. After the sixth annealing, the socket should be discarded. It should also be noted that the neck or throat of the socket is rounded to reduce the wear and cutting of the rope.

Where "long" splices are permitted, such as on endless cable roads, etc., it should be noted that the overall length of the splice in feet is about thirty-two times the diameter of the rope in inches. The strand ends, if properly tucked in, will be difficult to locate.

Attention should be given to the lubrication of the rope. Wire ropes are thoroughly impregnated with a lubricant during manufacture, but this oil gradually oozes out during use. Frequent application of proper lubricant during service is necessary to prevent the hemp core from becoming dry. A dry core rope will wear and crush more quickly than a lubricated one; also it will absorb moisture more readily which will result in interior corrosion of the rope. The lubricant must be sufficiently thin to penetrate to the center of the strands and of the rope, yet it should be viscous enough not to run off or to be thrown off by a rapidly moving rope. Hoisting ropes should be lubricated at least once a month, and more frequently when conditions require.

On traction drive elevators only a small quantity of very thin oil is used on the ropes in order not to reduce the adhesion between the ropes and the drum. When any rope is observed with the lubricant dry and flaked, it should be cleaned with a wire brush and new lubricant applied. When ropes are to be idle outdoors for a prolonged time they should be heavily coated with a heavy protective lubricant. Tar or compounds containing asphalt should not be used.

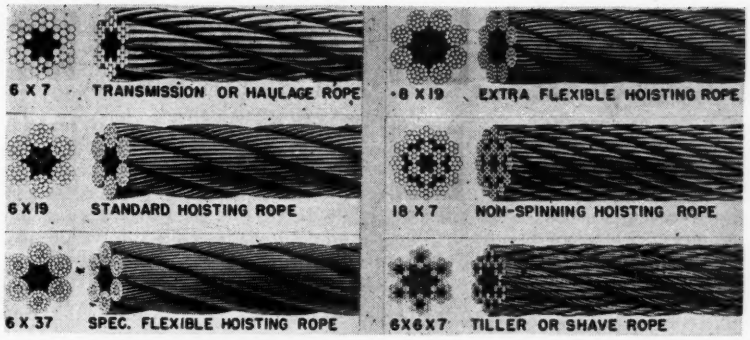
Where ropes habitually depreciate rapidly at one end due to the character of the equipment upon which they operate, it is economical to reverse the ropes end-for-end before they become bad enough to condemn.

It is recommended that all wire rope issued from the company storehouse be identified by a metal tag bearing a serial number which will in turn afford such pertinent information as the date issued, quality of the rope (cast steel, flow steel, etc.), manufacturer, etc. Some or-

Table II. Where the personal and property hazard is not great these more liberal wear factors may be allowed

Use	Conditions	6x19 Warr.	6x37	8x19 Warr.	6x19 Seale	Other Conditions
Cranes	Total	18	30	24	—)	Wear on outside wires
	Adjacent	4	6	4	—)	in excess of 33%.
Hoists	Total	24	—	32	—)	
	Adjacent	5	—	5	—)	
Passenger Elev.	Total	12	—	16	8)	Wear on outside wires
	Adjacent	4	—	4	3)	in excess of 33%.
Freight Elev.	Total	13	—	18	9)	Wear on outside wires
	Adjacent	4	—	4	3)	in excess of 33%.

*Part I appeared on page 72 of the March 1940 issue.


6 X 7 TRANSMISSION OR HAULAGE ROPE
8 X 19 EXTRA FLEXIBLE HOISTING ROPE
6 X 19 STANDARD HOISTING ROPE
18 X 7 NON-SPINNING HOISTING ROPE
6 X 37 SPEC. FLEXIBLE HOISTING ROPE
6X6X7 TILLER OR SHAVE ROPE

Typical wire ropes. The first figure indicates the number of strands, the second the number of wires in each strand, i.e. 6 x 7 is 6 strands of 7 wires each. Regular lay is with the wires in each strand laid one way and the strands laid the other. Long lay is with wires in the strands and the strands themselves laid the same way. Either lay may be right or left. 6 x 7 is a general haulage rope and the large wires are resistant to abrasion. 6 x 19 is standard hoisting rope, more flexible than the 6 x 7 but not as resistant to abrasion because of the smaller size wires. 8 x 19 is still more flexible and is intended for use with relatively small sheaves and drums. The 6 x 6 x 7 with 252 wires is the most flexible of all but the small wires stand little abrasion and it is used for signal and control purposes. (Photos, courtesy American Steel & Wire Co.)

ganizations use a 1 in. length of aluminum tubing, just large enough to slip over one strand of the rope at the seizing, socket or eye splice, with the serial number stamped on it.

Where it is not desirable to do this, only one grade of rope should be kept in stock, as if several grades are stocked there will be no means of differentiating between them once they are removed from the manufacturer's spools, and accidents may result from assuming a rope to be of a higher grade than it actually is.

As can be learned from the above text, properly inspecting a wire rope is a man-size job. It is only after years of experience, together with a good knowledge of the technical properties of rope, that an inspector can learn just when it is economical to condemn a wire rope and still be thoroughly safety-minded.

Building Insulation for Air Conditioning

INSULATION OF BUILDINGS to conserve or to exclude heat involves several factors not found in duct or equipment insulation. To start with, if the building was not designed for cold storage, it will be possible only in rare instances to insulate a large percentage of the superficial area. In the case of residences, any insulation that is 100 per cent effective would only reduce the heating or cooling load by about 50 per cent. The balance of the heat passes through windows, doors, door and window openings, by air infiltration, etc., and there is no such thing as a 100 per cent effective insulation, or a material with a conductivity of zero.

In most commercial and factory buildings the amount of wall area that can be effectively insulated is small, but the relatively large roofs provide transmitting areas of great importance. In this climate, during the summer, the surface temperature of a flat or slightly sloped roof will often reach 130 to 140 deg. F. and it is this temperature that is important in calculating peak loads for uninsulated and relatively thin structures.

If the roofs are well insulated or comparatively thick and heavy, it is not necessary to consider the surface temperature in calculating peak loads because there will be a decided lag in temperature rise through the structure due to the heat capacity of the materials, which is equal to their weight times their specific heats. For such installations, a figure somewhat above the maximum temperature difference expected is adequate for peak load computations.

Insulation of buildings can often be easily justified by improved economy of heating. When cooling is considered, there can be no question about its desirability and often it is absolutely necessary.

Notes on Stoker Operation

By A. Bement

LARGE UNDERFEED STOKERS originated in the east where coal containing ash of high fusion temperature was available. The author's first experience with them was through the Taylor stokers at Providence, R. I., the installation which influenced the New York Edison Co. to use them in its Waterside Station. After the stokers had been in operation some time I asked Mr. Sparrow, the then operating engineer, for his opinion. He said, "They are all right, although we are confined to two certain mines for fuel supply because of clinker trouble."

The Edison order for 10 stokers gave the maker confidence. Office quarters were taken in the Singer Tower, at that time New York's most important business structure and an active campaign was undertaken for orders from the electric power industry. An installation was made at Chicago replacing a chain grate in the old Harrison St. Station of the Commonwealth Edison Co. The fuel used by the Edison Co. was Illinois screenings of 10,000 B.t.u. carrying 14 to 16 per cent ash of a readily fusible character. The result of the test was unsatisfactory.

Soon, however, excellent performance was reported from the same type stokers at the plant of the then Western Tube Co. at Kewanee, Ill. While the fuel used from local fields was inferior to that burned by the Edison Co. at Chicago, an efficiency of 80 per cent was realized at 200 per cent of rating with no clinker trouble whatever. The fire was not allowed to approach the bridgewall or to extend onto the dump grate while the fire was carried thick at the front of the stoker. The result was enormous clinkers, due to high ash of the coal used, but they arrived at the end in a cold condition and could be dumped without trouble. In this case a perforated steam pipe along the side wall was employed to prevent side wall clinkering.

Another early installation of underfeed stokers was in the electric power plant at Cedar Rapids, Iowa, using local coal screenings of much higher eash content and of much more objectionable character than the fuel used at Kewanee. The method of operation was similar to that at Kewanee and local coal which ran 20 per cent ash or more was successfully used.

It would appear that much of the trouble experienced in the past has been due to an attempt to impose Eastern methods of operation to Western conditions. Or, in other words, to treat coal with fusible ash the same as coal of high fusion ash. If ash does not melt there is advantage in extending the fire over the dump grate and to the back wall of the furnace but with fusible ash this practice is fatal.

This problem attains increased importance where market areas join, as an example, an industrial plant in Indiana used West Virginia coal from certain selected mines but became interested in the cheaper coal from Saline County, Ill. The stokers were exceptionally large underfeeds provided with dump grates giving 200 per cent rating at a good efficiency.

Earlier experience with West Virginia coal showed that by carrying a heavy fire over the dump grate and against the back wall and extending cleaning period to once in 24 hr., a considerable labor cost for ash handling could be effected. It was thought desirable to combine the advantage of the economy of the Illinois coal with labor saving of the new method of fire cleaning. This required the Illinois coal to run for 24 hr. without cleaning. It was tried against the advice of the coal company's engineer and clinker trouble and stoker damage resulted.

The first installation of chain grate stokers in the west was at the Columbian Exposition in Chicago while they were still a novelty. The representative of the maker in giving instructions for operation recommended and endeavored to attain a thickness of fire on the back of the grate equal to that at the front. In other words to endeavor to develop a flat grate hand fired condition. This eastern operating influence appears to be at the bottom of most of the trouble had with handling fusible ash.

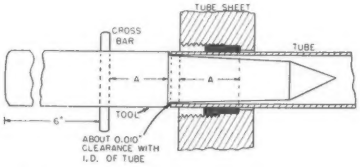
CONDENSER PRACTICE

Condenser Tube Packing

By P. F. Rogers

When condenser tubes leak, any one of several things may be responsible. The packing may be loose in which case the leak may be stopped by tightening the gland or ferrule so as to compress the packing. When this is done care must be exercised not to buckle the soft tube nor to bring the end of the tube tight up against the shoulder of the ferrule as is likely to be the case if there is not sufficient packing. If this is done the tube cannot expand and may buckle or be crushed at one of the support plates.

Again the end of the tube may be crushed in. This can happen if the ferrule has been screwed in too far or if too much packing has been used. Some packing swells considerably after it is wet and if this has not been allowed for when the ferrule is screwed in, the swell may crush the tube and



Tool Used for Driving Condenser Tube

it will leak. When a condenser has been out of service for some time, so that the packing has dried out, the glands should not be tightened until the packing has been soaked thoroughly. If glands using packing of the fiber or duck type are tightened up while dry a large number of tubes are likely to be damaged.

If too much packing of the corset lace type is used the end of the gland may not cover the end of the tube when it creeps to one end and the packing will gradually work out due to the action of the water. Sometimes a tube splits or corrodes so that it has to be replaced.

When the packing has to be taken out either to renew it or because the tube has to be replaced, it can sometimes be taken out with a pick and hook of the same type used for taking any kind of packing out of a stuffing box. Because of the working space, this is always difficult and with some types of packing impossible because it swells up and sticks to the threads.

It can be done more easily by taking the ferrule off both ends of the tube (some condensers have a ferrule on only one end, especially if metallic packing is used and if one end of the tube is rolled there may be no ferrule used at all and in that case this method cannot be used), and driving the tube back so that the old packing can be buckled inward with a pick and easily removed. A tool with which to do this is shown in the accompanying sketch. It is, however, easy to drive the tube too far and if it goes entirely through the tube sheet the end may spring up, due to the bow caused by the center support plates. When this happens, it is difficult to catch the end and draw it back in place. To prevent this happening, a cross bar may be added to the tube and this prevents the tube from being driven beyond the depth of the stuffing box. The end of a condenser tube is easily damaged and the tool should be hammered lightly with a wooden mallet or rawhide hammer.

Replacing Condenser Tubes

By F. Paul

From time to time, even in the best regulated power plants, it is necessary to replace condenser tubes. It is much more difficult to replace a single tube than it is to retube the entire condenser because it is impossible to put a man on the inside to guide the tubes through the support plates and opposite tube sheet. A common and very simple method used with single tubes is to first run a small pipe through the defective tube and hold it in place while the old tube is withdrawn. The pipe then serves as a guide for the new tube as shown by the drawing. We used this method successfully but found that an old condenser tube one size smaller was easier to handle and served the purpose better than did the iron pipe we had been using earlier.

That was it was satisfactory with the old condensers but did not work so well with a new condenser with longer tubes where the support plates were higher and gave a greater bow to the tubes. After some experimenting we solved the trouble by making a tool as shown by the sketch attached. This is made from a piece of pipe drawn down and then ground with a long taper and smoothed off so that it goes through the hole in the tube sheet easily. We use this with a ⅛ in. pipe and when the new tube comes up against the opposite tube sheet we slip the tool over the pipe until the taper fits snug in the tube. This gives a man a firm grip on the new tube and he can get it through the tube sheet without difficulty. It can be done even without a light which is otherwise necessary to get the tube lined up with the hole, which has only about a sixteenth clearance, and without having to depend upon man at the other end of the tube to push at the proper time.

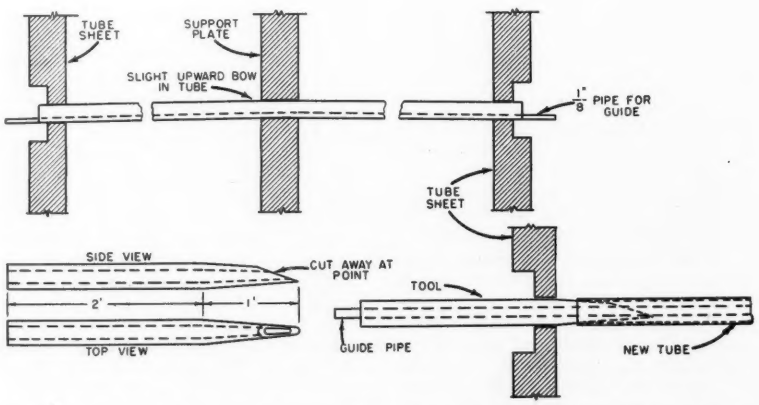
When the new tube comes up against the tube sheet the tool is slipped over the guide pipe with the point at the top. Due to the bow in the tube there is plenty of clearance here and the tool is slipped in until the tube is snug on the taper. It is then turned a half turn and this fits it up good and snug so that it can easily be guided through.

Cleaning Double Pipe Ammonia Condensers

By A. G. Solomon

Clean condenser surfaces with an evenly distributed and sufficient amount of water are two important things which the refrigeration engineer must watch for ammonia is simply a transfer agent to take the heat load from the produce, brine or water, and carry it to the condenser where it is unloaded into the water.

As the real work in a refrigerating plant is done in the condenser it is necessary to see that the greatest possible heat exchange takes place. Cleaning sludge, dirt and scale from the inner tubes of double pipe condensers is a problem where a little practical experience is of great value for many of these are older installations made with little or no consideration of the maintenance requirements. I happen to be one of the old time engineers who



Use of a guide rod facilitates replacement of condenser tubes. Details show the construction and use of a tool for guiding the tube through the second tube sheet

had double pipe condenser cleaning to do long before there was any provision made for such cleaning.

My first encounter was in a plant where the water was not a real hard scale maker. The 12 high condensers were back-washed once a week and to the engine room crew, the condensers were clean. On close inspection at the end of a year, however, we found a hard scale about ⅛ in. thick in the two top tubes. The scale was a little thinner in the third and fourth tubes and with practically none in the tubes below the sixth tube from the top.

This condenser was cleaned by using a drill, made like an Indian arrow head of tool steel tempered very hard, forced through the tubes on the end of a length of ½ in. pipe. One man power was applied at the end of the pipe from a handle made by a tee bull headed on, and, with 12-in. pieces of ½-in. pipe screwed in each of the side openings of the tee. It was hard work and took considerable time.

In subsequent years I have been up against all kinds of water and have tried every method of cleaning condensers of every kind. Air, water, chemicals and expansion and contraction all have their place but I believe that in general mechanical cleaning is the best, quickest and most satisfactory method. My favorite cleaner for internal surfaces of pipe and tubes is the rotary type and for external pipe or tube surfaces the vibrating type, or knocker as it is often called. When the rotary cleaner is not in use it should be removed from the hose and kept covered in a pail of oil. The twist drill is second choice for the cleaning of inner surfaces of either pipe or tubes. If power or air is not available for driving the twist drill use a length of ½-in. pipe with the handle made of a tee and 2 short pieces of ½-in. pipe.

Oil Level Indicator

By K. B. Humphrey

THE OIL LEVEL indicator on one of the large synchronous motors became loose one day and the oil started to run out. It happened, luckily, that one of the men happened to be in the motor room. Apparently at some time or other the brass holding the glass had been put back using a cord to make up the joint which had become loose from vibration. This gave way and it was impossible to screw it back in. The man held his thumb over the opening and called for help. A wooden plug was shaped and fitted and the bearing filled up to take care of the lost oil. The bearing was on the outboard side of the motor. Another glass indicator was not available. The problem was solved by a few pipe fittings and an ordinary oil well level indicator of the conventional L type with a snap lid. A nipple was cut to the correct length so that the oil would not overflow when the correct level was obtained. This type of indicator is very sure and if it is desired to test whether the pipe has become stopped up it is only necessary to take a small pipe wrench and turn the pipe and fitting down for a moment. A good flow of oil indicates that everything is all right. It is felt that this type of indicator is superior to the glass, as it can not be broken so easily, and it makes it necessary for the inspector to actually go to the bearing rather than depending entirely upon visual inspection from a distance.

Fuel Taxation

WHILE DISCUSSING the characteristics and requirements of tractor fuels at a recent S.A.E. meeting, E. L. Barger, associate professor of agricultural engineering at Kansas State College, mentioned the effect of non-uniform state taxing procedures on commercial fuels. An abstract of his remarks follow:

Upper distillation or volatility limit used by the states in defining a taxable motor vehicle fuel has a decided influence on the distillation characteristics of the so-called tractor distillate or heavy fuels sold in those states. The difference in the requirements in the various states explains why in many cases tractor distillates made for and sold in one state differ from those sold across the line in a neighboring state. Figure 1 shows some of the lower volatility limits used by various states to define a non-taxable fuel.

Performance tests were run in our laboratories on nine distillates ranging in octane numbers from —7 to over 40, in two tractor engines. A Hercules OOC power unit with a 3.90 compression ratio was used in the first series of tests and a McCormick-Deering P200 power unit with a 4.10 compression ratio was used in the second series. Briefly, the results may be summarized as follows: A fairly close correlation exists between the thermal efficiency and the octane rating of a distillate at the heavier loads, at which point detonation becomes a limiting factor as regards thermal efficiency. The higher octane fuels detonate less at the heavier loads and therefore maintain a relatively higher efficiency compared with the low-octane distillates.

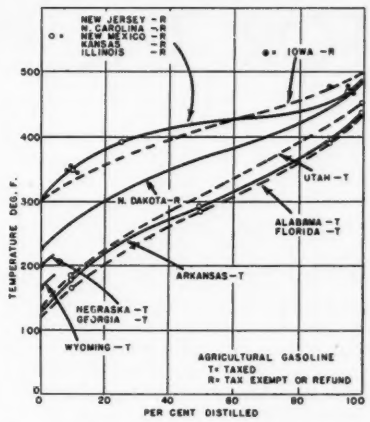


Fig. 1. Distillation value below which fuel would be taxed or tax refund procedure required

At low loads, however, there was an apparent tendency for the lower octane fuels to show a higher thermal efficiency than the higher octane fuels. The explanation for this may probably be that the very properties which promote detonation at heavy loads may cause relatively complete combustion and higher temperatures at lighter loads. On this theory the low-octane fuels would tend to give better performance at the lighter loads. However, it is the performance with heavy loads which is of major importance in tractor operation.

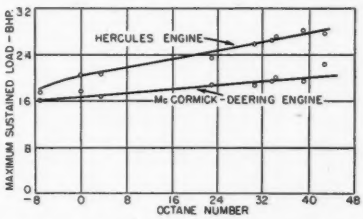


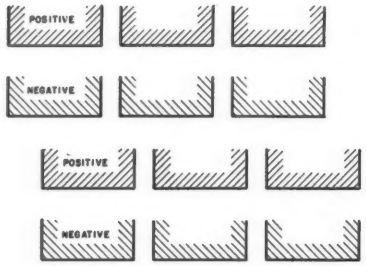
Fig. 2. Engine tests showing effect of fuel on operation with not more than medium detonation

The relationship between brake horsepower at maximum safe sustained load (medium detonation) and the octane rating of a distillate fuel is quite definite as may be seen from Fig. 2. For both the Hercules and McCormick-Deering engines there is a fairly direct relation; that is, the higher the octane number, the greater the maximum safe sustained load. From the curve for the Hercules engine it should be noted that while the engine could develop 27.4 b.hp. on a 40-octane distillate, its output using a 0-octane fuel was only 20.4 b.hp., a power reduction of 25.5 per cent. For the McCormick-Deering the curve indicates that the power output with fuels of the same two octane ratings would be 19.9 b.hp., and 16.8 b hp. respectively, a reduction of 15.5 per cent.

FOR THE PLANT ELECTRICIAN

Staggered Brushes

BRUSHES on commutators must be carefully adjusted and the brush holder spacing should be uniform around the circumference within plus or minus $\frac{1}{32}$ in. This can be checked conveniently by a tape around the commutator. Brushholder arms should be staggered in pairs in an axial direction approximately $\frac{3}{8}$ in. to prevent grooving of the commutator, the method recommended in Westinghouse



Maintenance Hints being shown by the drawing. D.c. brushholders should be adjusted so that the pressure on all brushes is as uniform as possible to prevent selective action by which certain brushes may take more or less than their proper share of the load. Brushes should be checked frequently to make sure that they move freely in the holders. Any found sticking can be freed by sanding the high spots with fine sandpaper.

Emergency Cable Vulcanizing

CABLE SPLICES, made in the field, give satisfactory service if properly made. A non-soldering joint for a single conductor cable was described on page 72 of the April issue. Frequently it is necessary to vulcanize the joint in the field and no equipment is available. To take care of this condition, temporary vulcanizing equipment can be constructed as indicated by the following directions.

An open-top vat should be used, large enough to allow the entire joint to be submerged in the heated liquid. Paraffin is generally used in the vat but any wax with a high boiling point can be used. In no case should oil be used.

After the joint has been constructed in the usual manner, it should be placed in a mold. This can be easily constructed by splitting a piece of pipe with approximately the same inside diameter as the completed splice. The two pieces of pipe should be held tightly on the joint by wrappings of wire, metal tape, or U-clamps. Another method is to drill, in a metal block, a hole approximately the same diameter as the splice, split the block in half, and place it over the joint. The two halves of the block should be held tightly together by means of bolts or clamps.

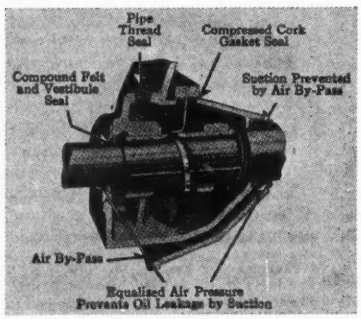
If it is practical, the molds should be heated before they are placed over the joint and the inside should also be coated with mold dressing to obtain a workmanlike finished splice. A saturated solution of soap chips makes a satisfactory dressing. In vulcanizing a joint with this equipment, make up the joint in the usual manner. Preheat the molds up to 275 deg. F., coat them with a mold dressing and clamp over the joint.

The paraffin vat should be heated to and held at from 275 to 300 deg. F. Place the joint in the heated paraffin with the entire joint and mold submerged. Keep there for a period of time depending on the size of joint and the thickness of rubber, holding the temperature of the paraffin as nearly constant as possible. The exact time for curing a splice can best be obtained by experience with the particular equipment used but the approximate time, given by General Electric as a rough guide for complete splices, is as follows: $\frac{3}{4}$ in. and smaller cables, 20 min.; $\frac{3}{4}$ to $1\frac{1}{4}$ in., 25 min.; $1\frac{1}{4}$ to $1\frac{3}{4}$ in., 30 min.; $1\frac{3}{4}$ to $2\frac{1}{4}$ in., 35 min.; $2\frac{1}{4}$ to 3 in., 40 min.; 3 to $3\frac{1}{2}$ in., 50 min.

When the splice is cured, it should be removed from the vat and allowed to cool for a time before removing the mold. Perfect results cannot be obtained with temporary equipment, but G.E. reports that carefully made splices vulcanized in this way can be expected to give satisfactory results.

Sleeve Bearings

BEARINGS and lubrication are of the greatest importance because failure of a bearing allows the rotor to rub against the stator. An analysis of induction motor failure confirms this and shows bearings to be the principal offenders. In recent years the simpler sleeve type bearings have been largely superseded by the sealed sleeve type which requires very little attention, since the oil does not become contaminated and oil leakage is negligible. A typical Westinghouse sleeve bearing assembly is shown by the drawing. Because of its viscosity or resistance to flow, oil is dragged along by the rotation of the shaft so as to form a wedge shaped film between the shaft and the bearing which completely separates the bearing surfaces so that there is no metal to metal contact. There is, therefore, no bearing wear when running. Formation of the wedge shaped film of oil causes a slight lift of the shaft. The thickness of this film has been carefully measured. The range is from a little under 0.001 to a little over 0.003 in.


Pipe Thread Seal
Compressed Cork Gasket Seal
Compound Felt and Vestibule Seal
Suction Prevented by Air By-Pass
Air By-Pass
Equalized Air Pressure Prevents Oil Leakage by Suction

Two outstanding considerations govern the design and maintenance of sleeve bearings. One is to insure at all times the existence of an oil film between journal and sleeve, and the other is to keep the destructive effects of metal-to-metal contact to a minimum when the oil film is lost as during starting, or by accident. The real advantage of the ball and roller types of bearings over the sleeve type is in the starting friction which is practically the same as the running friction. This unfavorable comparison does not apply under running conditions, when the oil film has been established.

Ohm's Law

IN ELECTRICAL work three factors are always involved. These are: the potential E measured in volts; the current I measured in amperes; and the resistance R measured in ohms. The relation between these three quantities is shown by the first line of the accompanying formula. With direct current, where power factor, is not involved the basic formula for the power loss W in watts is the product of volts and amperes. This combined with Ohm's law makes it possible to develop 9 separate relations between various combinations of the four quantities E, I, R and W. These are also shown by the three lower rows of formulas. Thus when a 20 ohm resistor is shorted across a 6 v. circuit the current flow can be found as follows:

$$I = E/R = 6/20 = 0.3 \text{ amps.}$$

Similarly the power used would be:

$$W = EI = 6 \times 0.3 = 1.8 \text{ watts}$$

$I = \frac{E}{R}$	$R = \frac{E}{I}$	$E = I \times R$
$W = E \times I$	$E = \frac{W}{I}$	$I = \frac{W}{E}$
$W = I^2 \times R$	$I = \sqrt{\frac{W}{R}}$	$R = \frac{W}{I^2}$
$W = \frac{E^2}{R}$	$R = \frac{E^2}{W}$	$E = \sqrt{R \times W}$

If the current was of no interest, the watts could be found direct from the voltage and resistance by using the first formula in the bottom line. The heating effect or loss due to resistance is what determines the carrying capacity of a conductor for a given voltage drop.

LETTERS AND COMMENTS

"When You and I Were Young, Maggie"

FOR ITS historical interest in connection with powerful steam engines, I would like to mention the Deutschland of the Hamburg-American Line which held the Atlantic crossing record in 1900, from New York to Plymouth at an average speed of 23.36 knots. It was powered by two quadruple expansion engines, designed by Dr. Gustav Bauer in the late 1890's, each of which developed 18,470 i.hp. at 77 r.p.m. but on its record run averaged a total of 37,000 hp. for the two engines. They operated at 214 lb. pressure with a cutoff of 70 per cent, giving 12 expansions.

During the late 1890's, under that great chief John Walls and also later under William Joyce, John Carstairs and Samuel Round, I had experience with the two quadruple expansion engines of the St. Louis. These operated on 200 lb. steam and with 70 per cent cutoff gave 10.4 expansions. At 91 r.p.m. each engine developed 10,400 i.hp. With a 5 ft. stroke the rated piston speed at 91.4 r.p.m. was 914 ft. per min.

While I know that employment of "Whirling Dervishes", i.e., turbines, is progressive, I have never been able to enthuse over them as I did over the reciprocating marine, reversible blooming mill and Corliss engines.

Louisville, Ky. HARRY CORNELL

* * *

EDITOR'S NOTE: *Marine engines carry a constant load day in and day out so that sizes are not directly comparable to other services. Yet Mr. Cornell's reference to steel mill engines warrants mention of some large uniflows. In 1924, Republic Steel installed a Nordberg Uniflow with duplex 60 by 60 in. cylinders, rated 16,000 i.hp. at 90 r.p.m. (990 ft. per min. piston speed).*

This was a material increase over the four cylinder engines of the same type installed by the Wheeling Steel at Steubenville, the year before, for continuous mill service. The cylinder size was 36 by 60 in. and the engine developed 14,000 i.hp. at 75 r.p.m. (750 ft. per min. piston speed.) The largest, however, was the reversing blooming mill engines installed in the same mill at the same time. This engine, also with four 36 by 60 in. cylinders, developed a maximum of 25,000 i.hp. at 125 r.p.m. (1250 ft. per min. piston speed.) This we believe is the largest uniflow engine ever built and is thought to be still in service.

"Our Hero" Seems to Satisfy

EVERYBODY—that is, most everybody—seems to feel that Our Hero is entirely adequate to play his leading role in the "How Would You Do It?" contest without any other name. Mr. Kramer's judgment in sensing the desires of P. E. & E. readers is, therefore, vindicated.

A number of names were suggested, however, by several who felt that "by all means he should" be named or because a suitable name would make him a good running mate for "Pulverizer Pete." (We just can't keep that fellow out no matter what happens. Lots of people write in asking who Pete is and we are sorry to have to say that we are not free to tell who he is and admit regretfully that he is not a member of the P. P. E. staff).

The names suggested so far for our Hero are: Ope Rator; Mr. Any Engineer; Analyzer Andy; Probing Paul; Dubious Dan; Wondering Willie; and Searching Sam.

They Say

"PLEASE PUBLISH my appreciation for advice in the P. E. & E. section," A. H. P., Peterboro, N. H. . . . "It makes me feel proud that I was of some help to G. R. W.," W. M., Chicago, Ill. . . . " . . the feeling with us is entirely mutual both from the standpoint of yourself and the very splendid work you are doing in your magazine. I guess we both like meat even in engineering or publishing," M. S. K., Detroit, Mich.

We Follow the Golden Rule

IT WAS somewhat of a surprise to receive such a friendly and interesting letter. The average letter from a man in your position is, as a rule dry and right to the point. I want to thank you for the information and the friendly way in which you gave it.

Ajo, Ariz. PAUL J. FAHERTY

* * *

THE personal interest you fellows take in your readers is one of the outstanding virtues of your great publications, no wonder you have corps of loyal readers.

Augusta, Kan. J. C. DE FOE

* * *

PLEASE accept my sincere thanks for the interest you took in my inquiry regarding the article by Mr. Pearse, in the February issue, and also thanks to Mr. Pearse. Such service greatly enhances the value of your magazine.

GEORGE H. WEINDEL.

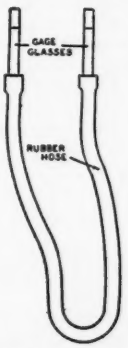
Cincinnati, O.

Is There a G-Man in the Audience?

FOR SOME WEEKS we have been waiting patiently for two men to complain that their letters were not acknowledged. We do not make a practice of inviting complaints, but we thought that this watch and wait policy might be effective this time so we could get their addresses and thank them for their fine spirit of cooperation. Louis J. Stark sent in an answer to the work schedule question; Paul J. MacGonigal sent in a solution of Problem No. 3, but neither sent in an address.

Rubber Hose Level

PERIODICALLY, that old millwright's device the rubber hose level is advocated as "simple and unfailing in accuracy." Having used and recommended this device myself I agree that it is an excellent and simple device but it is not always "unfailing in accuracy." On my recommendation a leveler of this type was used in a large factory for leveling shafting. The user was amazed to find that the apparatus was inaccurate and for a long while he couldn't understand why.



Presently it was learned that the error was due to the fact that one end of the hose was subjected to a higher temperature than the other, and as a result the column of water in the warmer end registered a higher level than the column in the cooler end.

Another thing to be careful about is entrapped air. If the hose is coiled when it is being filled with water, air may be trapped in it and unless all air is out there will be a difference in level due to that cause. When held in the position shown, entrapped air is not possible.

W. F. SCHAPHORST.

Newark, N. J.

How Would You Do It?

In Problem No. 9, our Hero ducks out and leaves Oscar worrying about a couple of valves and some friendly contemporaries who insist on using his boiler feed condensate for use in the process. Oscar doesn't mind this if it is necessary but they have been imposing upon him and using the condensate while there is plenty of treated water available. He wants an alarm system that will tell him what's what.

PROBLEM 9

Tank Level Indicators and Flow Alarm

OSCAR knows all the answers now—that is all except how much the boss will allow him to spend for the indicator alarm system he wants. With our Hero on his vacation it's all up to Oscar and he has collected enough data on feedwater conditions, boiler cleaning and carryover to prove that this alarm system is the only thing that will keep the company in business.

The boss may say "We've got to stay in business—regardless of cost—shoot the works, Oscar!" Again, unless Oscar gets to him before he finds out that Junior, fresh home from college and beginning at the bottom in the shipping department, sent the "Air Express Rush" order to Patagonia instead of Pennsylvania, he will probably say "Nuts! You're getting fat and need exercise—run down the stairs every 5 min. and look at the tank."

Inasmuch as Oscar is fundamentally a peaceful individual, Mr. Hensgen was awarded first prize on the basis of his solution; to provide the essential level indication; signal when condensate was being used; automatically cutting in the emergency line for the service intended; and automatically taking care of the "condensate steal" without involving hard feelings between departments by complaints or appeal to the management. It might be well to point out that the spark plug contacts used by Mr. Markland in Fig. 5 on p. 11 of this issue would fit in well with Mr. Hensgen's level indicator and also that low voltage would be desirable for safety's sake.

FIRST PRIZE AWARD
By Bernard Hensgen
Plant Engineer
Swift & Company
National Stockyards, Ill.

Upsetting boiler feedwater treatment is usually not to be taken lightly and any expense to which our Hero might be put to eliminate this situation would certainly be justified. The installation of an alarm and level indicator would not prevent the processing operators from needlessly using the boiler feedwater unless some means of stopping the flow in the emergency line is provided.

I would suggest that our Hero install a control system as shown in Fig. 1. This hookup would require a low level float in Tank B actuating an electric contact switch. The switch would be connected in a circuit with a motor valve on the emergency line and a signal light in the boiler room. The motor valve would be normally closed and only when Tank B was empty would the switch actuate the valve so that the emergency line would be open.

When this valve opened the fact would be communicated to the boiler room by the signal light. So that the boiler room foreman would know how much water was in Tank A a simple

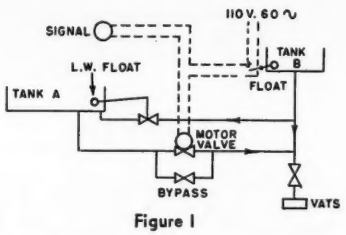


Figure 1

hookup as shown in Fig. 2 could be provided. This would indicate the water level by quarter tankfuls which should be sufficiently accurate for this purpose.

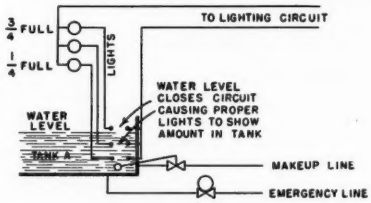
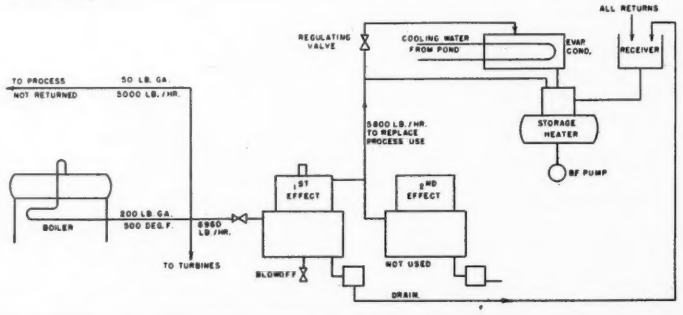


Figure 2

When the bottom light went out, thus indicating that there was less than one quarter tankful left, there would still remain some time for the foreman to take such action as he considers prudent and advisable. I would also suggest a simple swinging flap check valve be installed in the line to prevent the flow reversal at any time.

PROBLEM No. 10—PROCESS STEAM SUPPLY

Our Hero just can't keep his nose out of other people's business. On his vacation he went to visit a friend and found him complaining about having to carry a boiler load of 12,760 lb. per hr. to supply about 7,350,000 B.t.u. process load, requiring 50 llb. ga. pressure. There is no return from process and he figured he supplied 5800 lb. per hr. for process through the reducing valve, plus 6960 lb. per hr. to the evaporators to make up the 5800 lb. Water is bad and all feedwater is evaporated but the feedwater will not absorb the extra heat load and cooling water from the spray pond has to be used on the evaporator condenser. For some reason the second effect evaporator is not used. Our Hero is not the mental giant he thinks he is but he does know there is something screwey about generating 12,760 lb. of steam to supply a 5800 lb. load and the evaporator condenser cooling water looks to him just like dumping coal in the ocean. What's wrong? What can he do? How much will it save? What will it cost? All this has our good Hero batty—not that we care for we tried to get him to go to an insane asylum for a quiet rest instead of wandering loose around the country—but maybe some of his friends are more sympathetic and will help him out. Remember 1000 words—closing date May 25.



SECOND PRIZE AWARD

By Homer H. Crider
Yosemite National Park, Calif.

As this is a remote installation I believe that the Selsyn system is indicated here. Visual check on each of the two tanks is made possible for the foreman by installation of an indicator on each, consisting of a transmitter at the tank and receiver in the boiler room.

Tank B should have, however, a

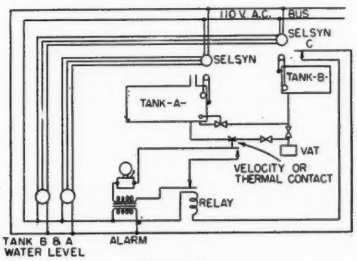


Figure 3

contact, C, (Fig. 3) to close a separate circuit at a given point on low water. This low water contact, C, is integral with the gears actuating the transmitter of the Selsyn indicator. This circuit operates a relay in the boiler room which in turn opens an alarm circuit; which would otherwise ring in case water is drawn through the emergency line. The fact that the low water contact indirectly opens the alarm circuit prevents Oscar from getting ruffled when the men get water from Tank A. However, just let them try to draw water from Tank A when Tank B has water in it. Oscar gets a buzz and can do his stuff.

The alarm circuit itself is actuated by means of a velocity contactor cut into the pipe circuit and does not restrict the flow, or, a thermal contactor can be installed on the pipe as long as this is a hot water line and not generally in use. The thermal bulb contactor would, however, have some time lag while the velocity contactor would be instantaneous.

THIRD PRIZE AWARD

By James O. G. Gibbons
Bloomfield, N. J.

There are, on the market, several makes of indicating instruments which would show the level, or even the number of gallons of water in Tanks A and B. (Brown Instrument Co., The Foxboro Co., Liquidometer Corp. and others), but to indicate a tank 1000 ft. distant would, no doubt, have to be of the electrical type. It is reasonable to assume that, to meet our Hero's needs, we shall have to design something which is comparatively cheap but, fortunately, it need not be extremely accurate.

As will appear from Fig. 4, a float chamber connected to Tank A is provided, under the firing aisle, or elsewhere if more convenient, and a rod from the float is run up and connected to a cord and counterweight to insure easy operation. Either the top of the rod or the counterweight can be used as an indicator, with a scale placed back of it, to show the height of water in the tank.

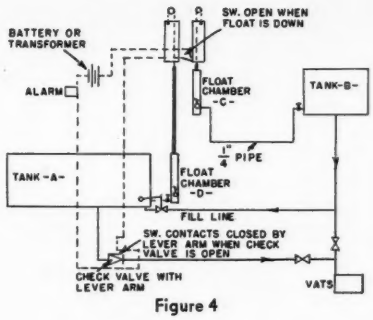


Figure 4

With regard to Tank B, I am afraid that we shall have to spend a little money, owing to the long distance from the boiler room, and also to the fact that the static head in the fill line will vary when water is flowing to the vats, or to Tank A. A ¼ in. line from Tank B to the boiler room, however, would not be so very costly, and it could be used to indicate the water level, in the same way as for Tank A. It would also take its part in the operation of the electric alarm system.

To satisfy Oscar, we could put a check valve, which can be obtained with an outside lever arm (Crane Co. Special) in the emergency line. When water flowed in this line, the check valve would open, and the lever move to a position where it would close the switch in the alarm system. In the same circuit there would be another switch which would only be closed when the required minimum amount of water was in Tank B so when there was not enough water in Tank B there would be no alarm when water flowed through the emergency line.

GENERAL COMMENT

B. F. Barrow from the Cascades, El Portal, Cal., submitted two solutions; one (but without explanation) somewhat similar to Mr. Crider's, the other as shown by Fig. 5, to sound the alarm only when Tank B has water in it. He

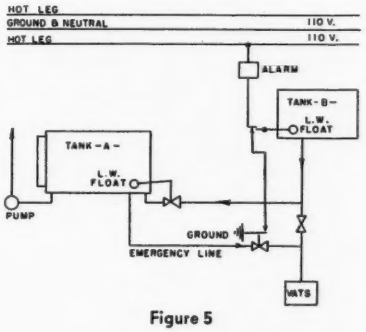


Figure 5

says: "Assuming that the plant is wired with the three wire Edison circuit: install a 110 v. bell in the boiler room; install a limit switch on or near the low water float valve base, on Tank B with a bell crank which will press against the switch level when the float begins to raise, close the switch and keep it closed as long as Tank B has water in it; install the same kind of switch near the valve on the emergency line; ground one terminal and place a bell crank on valve stem. To wire this circuit pick up one hot leg, take it to the low water float operated switch, then to the alarm bell in the boiler room and return to the valve in the emergency line.

With Harry E. Zeffren of St. Louis, Mo., it's whole hog or none and he does it all electrically. He uses (Fig. 6)

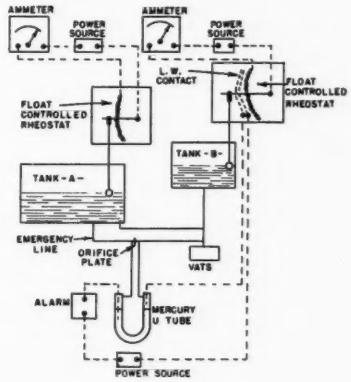


Figure 6

float operated rheostats and armatures for level indicators with special contact stripes on Tank B to cut out the alarm with low water. His alarm or flow indicator he describes as follows: "With respect to the alarm (which could be a bell, horn, or light) this could be operated electrically by means of an orifice in the emergency line, the connections to which would be piped to the two arms of a glass or steel U-tube containing mercury, with contacts arranged to make contact with the mercury in both arms when a differential appeared across the orifice, indicating a flow in the emergency line."

A. G. Nygord, Test Engineer for the C.I.P.S. Co. at Hutsonville, Ill., favors a simple pneumatic indicator for Tank B and the alarm circuit as shown by Fig. 7. Several mention the use of a check valve as a flow indicator and Mr. Nygord shows the details and gives the following explanation: "A swing check valve should be installed in the emergency line. This should have the hinge extend through the body of the valve so

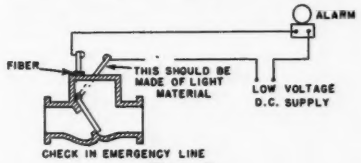


Figure 7

that a contact arm may be attached to it. A weighted check valve may be obtained and the weighted arm can be removed and replaced with an arm with a contact point. Figure 7 shows the method for adapting an electrical alarm to this arrangement. Thus the boiler operator can determine when condensate is being used unnecessarily by observing the level indicator when the alarm sounds."

Sig Hennig of Phillipsburg, N. J., would use two indicators and an alarm circuit with a float operated low water cut out on Tank B. The flow indicator he uses on Tank A is different from anything else suggested and a portion of his drawing is shown by Fig. 8. He describes the "contraption" as follows: "A large hollow brass ball 3 in. in diameter,

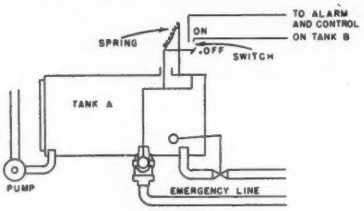


Figure 8

connected to a long brass rod is inserted into the large piece of pipe. A reducer is used to connect the larger and smaller pieces of pipes. The small outlet of the upper reducer should be very smooth to insure a good fit between the ball and its seat. The rod extends up through the tank and is connected to the switch by a lever and another rod which runs up through the vent. The lever and extra rod can be eliminated if the vent is located directly above the opening of the pipe line.

"The explanation of the contraption is: when flow is started through the emergency pipe line the velocity of the water forces the ball down, pulls on the rod and throws the switch. As soon as the flow is stopped the ball rises to its former position shutting of the alarm. The spring at the top is not needed if the ball can rise of its own accord back to its original position."

HE TRUSTS NOBODY

August Ludwig, Dundalk, Md., is skeptical of the honesty of the process men and would install a valve in the emergency line operated by an extension up to the boiler room. This might defeat the original purpose of the line. The alarm circuit from Tank B, using special contacts on a regular pressure gage has many applications and a portion of his drawing is shown by Fig. 9. The alarm contacts are installed as follows: "Through the glass face on the gage, drill a small hole to takea 3/16 in. brass bolt. By connecting one wire of a bell circuit to this bolt and the other to the gage frame, we can run this bolt in until the hand on the gage will rest against it to complete the circuit. By placing the glass so that the bolt is in a position of the lowest allowable head, we establish an alarm that could be placed in the boiler room to notify Oscar of the need for condensate in the vats. Take it from me this type of alarm is unfailing in its response and will give service as long as the gage is in order."

In connection with low water alarms, Harold D. Brown, Chicago, Ill., has a suggestion. "If it is not necessary to know the exact water level in the tanks a low water alarm made with an ordinary tumbler switch can be used. To make an alarm with a tumbler switch an ex-

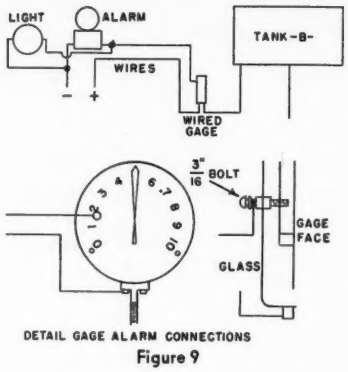


Figure 9

tension is fastened to the lever of the switch, Fig. 10. A slot is cut in the extension to fit over the rod on the float. The collars on the rod can be set to operate the switch at any levels desired."

WHY INSTALL THESE INDICATORS?

Donald Osterhoudt, Poughkeepsie, N. Y., offers no solution of the alarm system but makes some pertinent observations regarding the desirability for cooperation within an organization. With Mr. De Foe (p. 70 March) he feels "—it's up to the Management" and says: "I do not believe that any device which would give any one man or department a chance to complain to the management about the actions of another man or department is the proper solution to any problem that may arise in any plant. The tank level indicators which our Hero

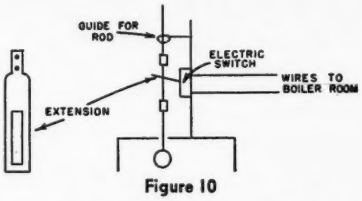
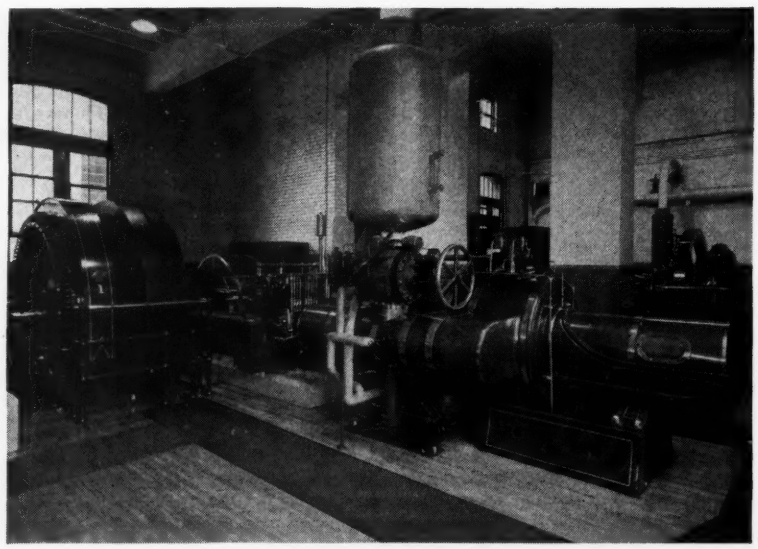


Figure 10

wishes to install in Problem No. 9 are devices of this nature. Such a device is neither an asset or credit to any plant.

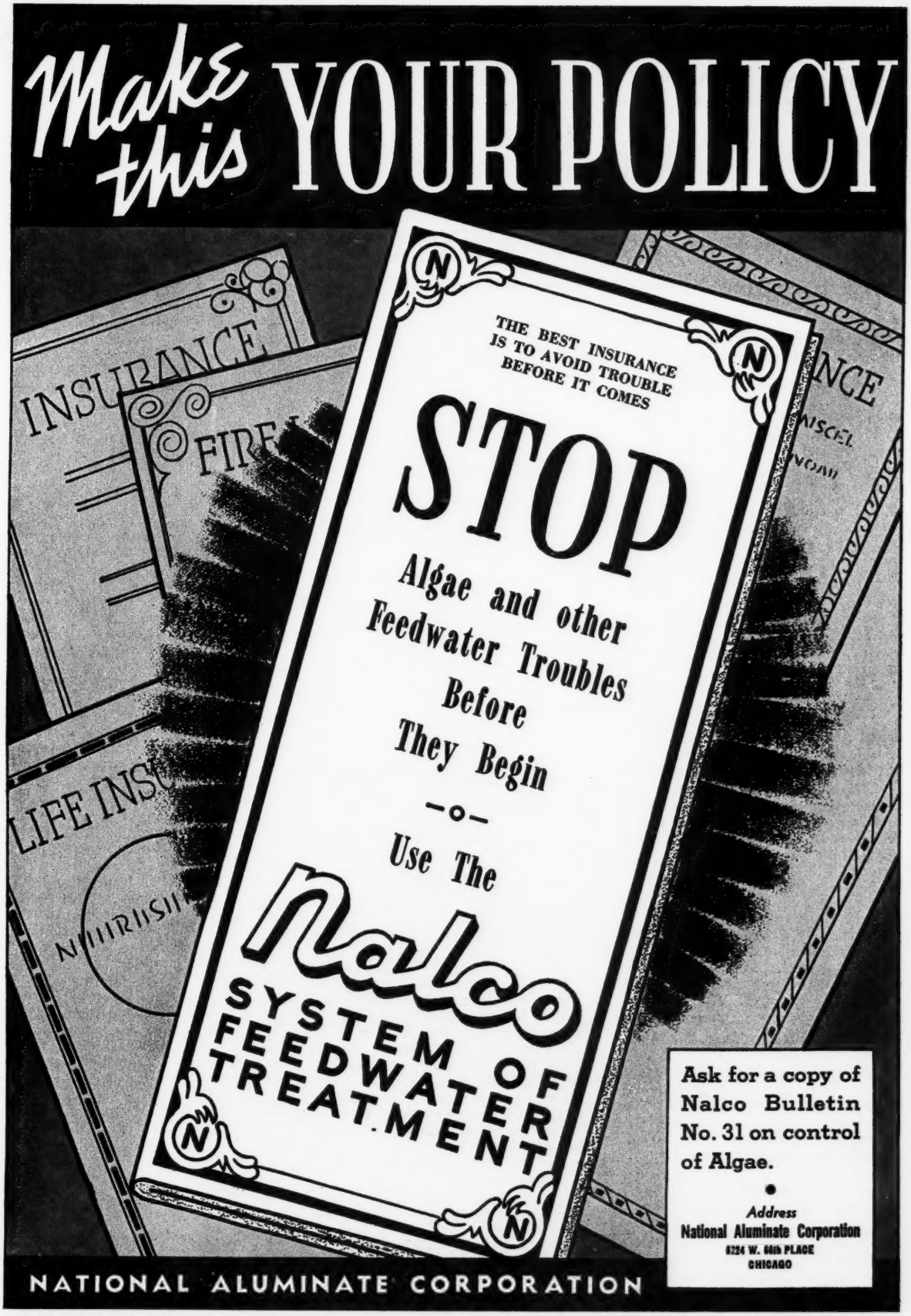
"The emergency line from the condensate storage tank to the vats was installed to avoid process delay due to low water in the softened water tank. After being installed for some reason the men at the vats preferred the hot water from the condensate storage tank. Why? Does it step process up a little more or does it mean an improvement in their working conditions? In any case it must be an improvement over the cold water or the men would not prefer it.

"It would pay for the management to get together with the men on this problem and find out just why the men prefer the hot water. It may be worth while to install a heater with a low water shut off in the softened water storage tank or to rearrange the water supply to the vats so that the men can use hot water at all times. If tank level indicators are installed it is bound to cause friction between the boiler house men and the men who work at the vats. Only when there is good feeling and cooperation between the men, departments and the management can best results be obtained."



Good Housekeeping

WHILE many engineers believe, and practice, the old adage "cleanliness is next to Godliness" many do not do so after 2 or 3 yr. a large number of new plants show decided neglect. As a rule the condition of the plant is a pretty good indication of the entire maintenance program and the condition of the equipment. This photograph of the Chicago Plant of the United States Tobacco Co. is one of the very good ones. Incidently the 164 r.p.m. 25 by 28 in. side crank engine in the foreground was installed about 3 yr. ago. It is a Skinner Universal Unaflow, designed to operate with 125 or 165 lb. steam at the throttle, 0 or 2 lb. back pressure, and drives a G.E. 350 kw., 3 ph. 60 cycle alternator and a 15 kw. V-belted exciter.



Inquiries other than domestic, *except those from U. S. Possessions, Canada and Mexico,* should be addressed to Alfloc, Ltd., Bush House, Aldwych, London, W.C. 2, Eng. Canadian inquiries should be sent to Aluminate Chemicals Ltd., 372 Bay St., Toronto, Ont.

Questions And Answers

Floc Formation in Water Treatment

FEEDWATER makeup is taken from a stream, heavily contaminated with sewage and trade wastes, heated from about 39 to 80 deg. F. and then flows to a chemical mixer where alum is added for coagulation. When the resultant floc is formed, it floats to the surface of the mixing tank instead of slowly sinking, thus appearing to require more alum to reform a floc which will settle in sedimentation tanks preceding the filters and Zeolite softeners.

1. Does the sudden rise in temperature cause the minute living organisms in the contaminated water to be destroyed and transformed into gas bubbles which become enmeshed in the descending floc and when enough are so enmeshed to float the floc to the surface of the water in chemical form?

2. With the aid of a settling tank would chlorine destroy the living organisms to the extent of preventing their gasification when passed through heater?

3. If you can find no justification for the use of chlorine can you find an answer to the question—"What causes floc to rise to the surface of the water of a chemical mixing tank rather than to settle to the bottom?"

Paulsboro, N. J. E. L. L.

* * *

HEATING to 80 deg. F. will not destroy organisms, but it will accelerate the liberation of gases. If very cold water that is saturated with air is heated, air comes out of solution. The alum floc may also rise because of grease or oil or

Prechlorination may be of help in oxidizing organic matter.

Addition of clay, activated carbon or sodium silicate may aid coagulation and form heavier floc particles that will settle more easily.

The main aid to coagulation would be the use of mechanical agitation for 20 to 30 min. If the correct speed of agitation is used, the floc formed will be much heavier and will not float.

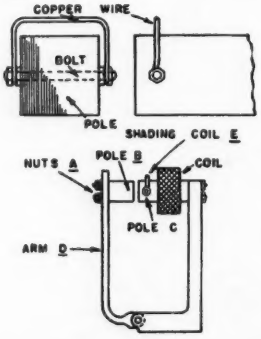
Another aid to coagulation is the recirculation of previously formed sludge. The sludge particles act as nuclei on which the new precipitates form. In the Spaulding precipitator all the precipitates are kept in suspension to act as nuclei and as the water continues to rise through the suspended sludge, the velocity of flow is progressively decreased by sloping sides until the sludge separates from the water and is left behind. Clear water emerges at the top.

S. B. APPLEBAUM

The Permutit Co.,
New York, N. Y.

More Magnetic Brake

ON PAGE 737 of the November issue A. H. Parker related his troubles with an electromagnetic brake. I experienced the same difficulties with an electromagnetic brake lock. The noise was partly overcome by shortcircuiting about half the pole by means of a shading coil. This coil consists of a small bolt going through the laminated pole, and a heavy copper wire which connects the ends of the bolt. The thickness of the wire must be found by experimenting as the noise is a minimum at a certain thickness.



In order to overcome the noise completely, I loosened the two nuts A, which fix the pole B to the arm D, a few turns. This allows the pole to move slightly relative to the arm and thus the whole surface of pole B comes to lie truly on the surface of pole C. The pole surfaces should be as smooth as possible. The position of the shading coil E is also indicated.

W. NEUMANN.

Johannesburg, South Africa.

Oil Difficulties in a Refrigerating Plant

ON PAGE 80 of the Feb. issue G.R.W. asks for help in cleaning his refrigerating system from oil and to keep the compressor from pumping oil. He surely has an oil trap between compressor and condensing coils. He should couple on to the bottom opening of it with a piece of hose or pipe leading down into a 5 gal. can or small oil drum. Just crack the valve under the trap and let it run until the oil is all out of the trap. He should do this every few days. He knows how much oil is being used per day and he can tell by looking at trap about how much oil it will hold.

To rid his system of oil if it has gotten down into his receiving tank there is just one way to clean it. Get some empty drums, drain the receiver into these and send to the factory and have it cleaned. Be careful to weigh the containers as they are filled so as not to put in more than the company recommends. After ammonia is all out he can let the gases escape by attaching one end of a garden hose at same outlet and putting other end of hose in barrel of water. When gas is all out he should pump up the system to 180-240 lb. and then blow out. Do this a few times and that will blow most of oil out of receiver. He can do the same with his brine tank. There is generally pipe leading from brine tank header to the outside.

To keep the compressor from pumping more oil most ice machine companies now days drill small holes in the piston from the bottom skirt up to the first ring. They tap them and put in flat head screws so that when the piston begins to pump oil one can take out some of these screws and that will do the trick. If there are none of these screws in his machine I would advise him to send and get some oil rings, one for each piston. Then I would have some small holes drilled in bottom ring groove before putting in the rings. He can go to a garage and see how a car piston is fixed for pumping oil and be guided accordingly.

Redmond, Ore. C. C. COLLINS

Alarm Circuits

ON PAGE 81 of the February issue, C.E. asked about high water alarm circuits involving both a lamp and bell, the latter to be cut out by a push button, the former to stay on as long as the water was high. Circuits using two types of relays were published on page 80 of the April issue. Others will be used later.

Still a third type of relay is suggested by Mr. Markland. The relay coil is in parallel with the lamp but the relay is locked open. Lifting the latch closes the single break contact and stops the bell, thus serving the same purpose as the push button in the other comments.

"Acknowledging relay in Fig. 4 is a Struthers Dunn midget relay with one back contact, S.P.S.B. No. BSX1 with

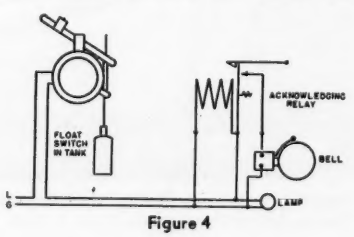


Figure 4

Designed with extra strength where needed, interchangeable parts, plus other features that save servicing time . . . . . .

LUNKENHEIMER *BRONZE GATE VALVES*

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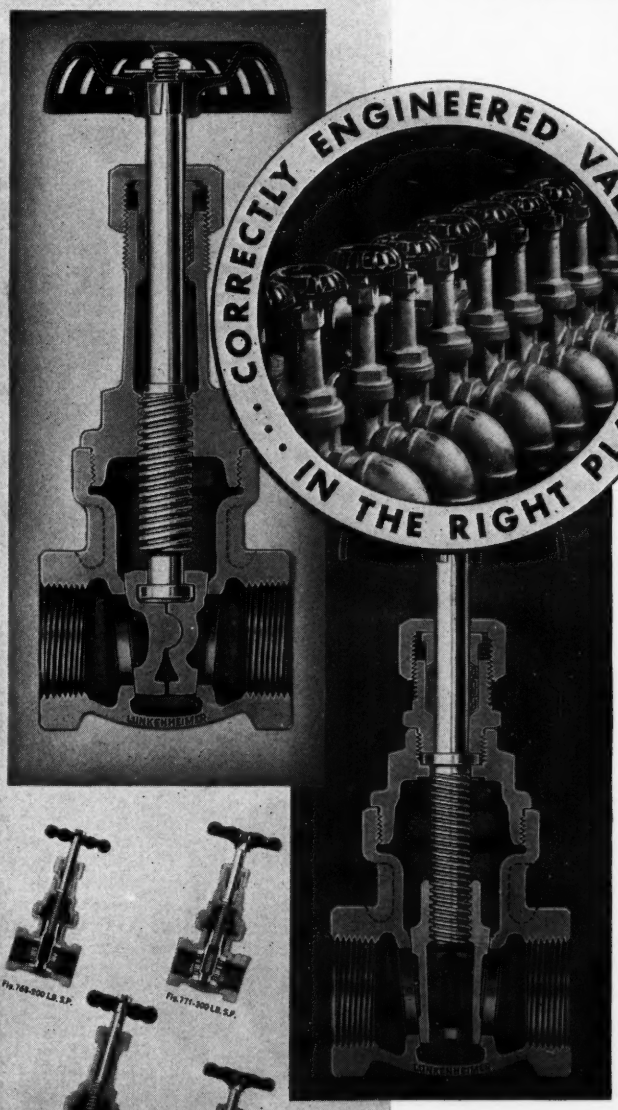

From handwheel to pipe threads, there are at least a dozen places to look for convincing evidence that LUNKENHEIMER BRONZE GATE VALVES first, give you more for your valve buying dollar . . . and then save you more on your valve maintenance dollar. Such features as unusually heavy body and bonnet construction, more powerful and accurately machined stem threads, exceptionally sturdy bonnet collar, extra deep stuffing boxes . . . these all combine to guard against failure at points where experience has shown that trouble is most likely to occur. Being an assembled job, with all units produced on a precision basis, any given part can readily be replaced from stock with full assurance of a perfect fit. Even comparatively small details, like beveled disc guides, to facilitate servicing, and the unique stem seat in bonnet, to permit repacking with valve wide open, play a part in the all-over economy of these quality products. You owe it to the profit side of your ledger to investigate the substantially greater value to be found in this line of "correctly engineered" bronze gate valves.

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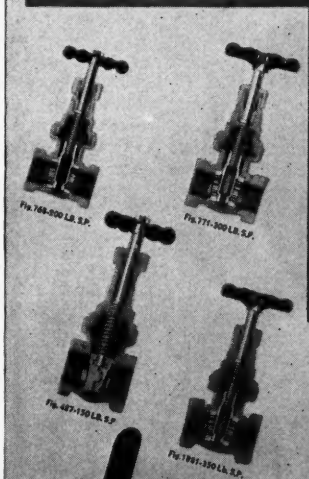
Naturally there are basic Lunkenheimer qualities, such as finer materials, continuous metallurgical research, painstaking manufacturing and testing processes, which cannot be seen in the products themselves. We do believe, however, that the purely visible qualities of Lunkenheimer valves will prove conclusively that they are inherently better able to serve you profitably. Won't you, therefore, ask our distributor's salesman, on his next call, to take a Lunkenheimer valve apart and compare it part-for-part with whatever valve you are now using?



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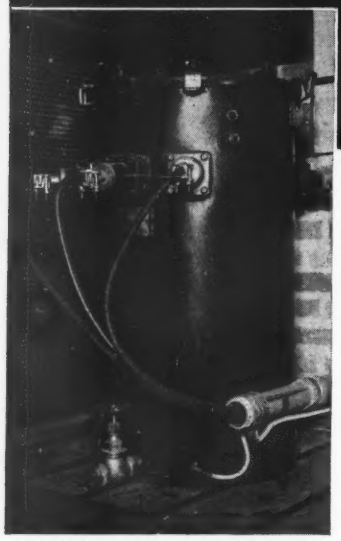

Profitable investment for Cranberry Canners, Inc., of South Hampton, Mass.—a 25-kva Pyranol transformer installed indoors *near the load center without a vault*

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1. You cut installation costs

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By installing Pyranol transformers right at load centers—even on overhead platforms if floor space is at a premium—you eliminate the need of long, expensive secondary feeders and cut copper losses to the minimum.

3. You save on maintenance

Because Pyranol is nonsludging and because Pyranol transformers are built with pressure-tight tanks to prevent evaporation and contamination, maintenance is much less than on oil-filled transformers.

It will pay you to investigate the possibilities of economical load-center distribution with Pyranol transformers. Ask your G-E representative for complete information, or write for Bulletin GEA-2637. General Electric Company, Schenectady, N. Y.

These 200-kva Pyranol transformers are installed in the motor room of the new cold-mill addition to the McLouth Steel Corporation plant, Detroit, Mich. They meant savings in installation costs, feeder costs, and copper losses, because *primary power was brought right to the load*

GENERAL ELECTRIC

402-6

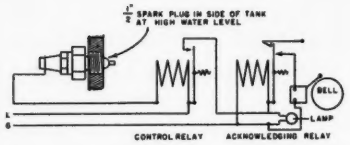


Figure 5

coil for 110 v. a.c. and with latch for holding contact in closed position.

"When the float switch closes on account of high water, current flows through the switch through the contact of the acknowledging relay and through the bell to the grounded side of line. It also flows through the coil of the acknowledging relay and the signal lamp. When the latch of the acknowledging relay is raised, the armature is pulled away from the back contact, thus silencing the bell. When the water level falls and the switch opens, the acknowledging relay armature drops back and is caught by the latch, thus resetting the relay for another alarm.

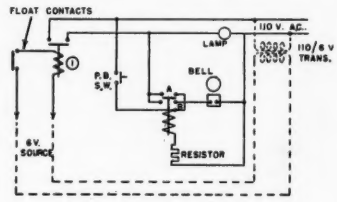


Figure 6

"The control relay in Fig. 5 is a midget relay with one front contact, S.P.S.B. No. ASBX1 with coil for 110 volts a.c. of the same make and the float switch in Fig. 4 is a float-operated control, Fig. 40, minimum float travel 1⅝ in., (Mercoid Corp.) with tube set to close contact on high water. Operation of the circuit is similar to Fig. 4 except that in the event of high water, current flows from the live side of the line through the coil of the control relay and through the center electrode of the spark plug to ground. This causes the contact of the control relay to close and operate the balance of the circuit the same as the float switch.

"The second method operates with a smaller variation in level than the first but may be put out of service by ice forming over the spark plug or rust coating the insulator."

A. R. MARKLAND
Altoona School District
Altoona, Pa.

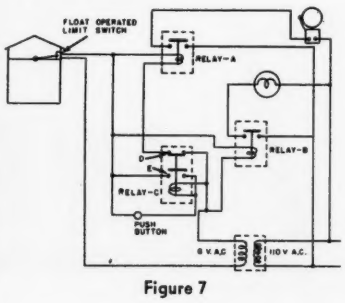


Figure 7

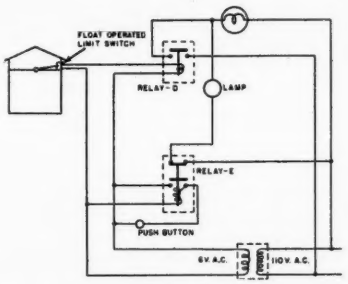


Figure 8

Still another variation is suggested by Bill Maddox, Tucson, Ariz., who uses a two winding relay with one make and one break contact, the float switch pulls the relay armature in and the push button cuts in and locks the second winding and releases the armature. The Automatic Electric Series AVC relay with vacuum contacts (6 amps.) with a two winding coil could be used this way.

When both 6 and 110 v. are used, a minimum of two relays are needed. Figure 6 shows the first circuit of this kind sent in by L. O'Brien, Minneapolis, Minn., who credits the basic idea to A. C. Finney, Switchgear Dept., General Electric Co. With the exception of relay 1 this is the same circuit as Fig. 1 (April). Note that Mr. O'Brien's contacts move up when the coil is energized and that he uses two low voltage relays, one supplied from the 6 v. line, the other from the 110 v. line through a resistor.

Milton N. Kraus, New York City, suggests the same arrangement but without the resistor so as to have one 6 and one 110 v. relay. He also suggests supplying the 6 v. through a transformer as shown dotted. The transformer was also included by Joseph J. Buffone, Clifton, N. J., but in a circuit using three 6 v. relays, as in Fig. 7, presumably to avoid 6 and 110 v. contacts on the same relay. Without this restriction the same result can be accomplished by two relays as in Fig. 8 but this obviously does not meet the same safety standards. These require no further explanation but note that in contrast to Fig. 6 the armatures move down when the coil is energized.

Top vs. Bottom Refrigerant Feed

WHAT IS the objection to introducing ammonia in the top instead of the bottom of cooling coils?

Van Buren, O. G. R. WILLIAMS

THERE is no objection we know of to top feed coils except that practically the capacity for a given cooler surface is materially reduced. This reduction comes about primarily through the difficulty of regulating the feed so as to get flooded coils and still avoid carryover of liquid to the compressor. In an up feed the circulation is in the natural direction and regulation to keep the top coils wetted is comparatively simple. With a down feed the liquid flows immediately to the bottom of the coil, and if carry-over is to be prevented the expansion valve must be regulated exactly.

This is not often practical with the result that the return gas is usually superheated, meaning that much of the coil surface is ineffective because a dry coil does not transfer as much heat as a wet one. Of course, when an accumulator is used, bottom feed is imperative because the circulation depends almost entirely on gravity.

* * *

"The above paragraph treats accurately the question of top feed as opposed to bottom feed. With top feed the liquid covers only a small part of the cross section of the pipe, while flooded operation wets the entire surface, almost up to the top of the coil. In addition to providing a much more rapid heat transfer because of the liquid-to-metal contact, flooded operation raises the suction pressure and results in a considerable power saving. The use of float control valves and suitable accumulators has made flooded operation the universal choice over top feed, except when Freon-12 or methyl chloride is the refrigerant. Positive return of the oil going over with or in these refrigerants can best be secured by top feed, unless a special oil return system is used."

Frick Co. TERRY MITCHELL

Waynesboro, Pa.

Armature Repairs

WE USE tinned steel wire for banding our armatures but we do not have very much of this work to do and the smaller sizes of wire carried in stock seems to develop small spots and to turn dark after being in stock about a year. When using the wire it will not solder evenly even if sand papered after the band is in place, sometimes the solder will not stick at all. What is this trouble and how can it be prevented? The place where the wire is stored is dry.

Albert, W. Va. FRED HARTMANN.

* * *

TROUBLE which Mr. Hartmann describes, we would say that this is quite often found on tinned wire which has been held in stock for considerable time. The trouble is a form of corrosion and is due either to defective tinning or subsequent chemical action from contact with corrosive material or atmosphere.

The first appearance and progress of these spots can be greatly retarded if not entirely prevented by keeping in a dry place as Mr. Hartmann states has been done, and in addition the wire should be carefully covered or wrapped. This will keep the wire clean and prevent contact by corrosive atmospheres. The temperature of the wire in storage should never reach the dew point of the atmosphere which surrounds it.

In cases where this "disease" has developed to the point where it prevents good reliable soldering, the wire should be discarded or retinned.

Westinghouse E. & M. Co.

East Pittsburgh, Pa.

C. DIAS.

Keeping Posted

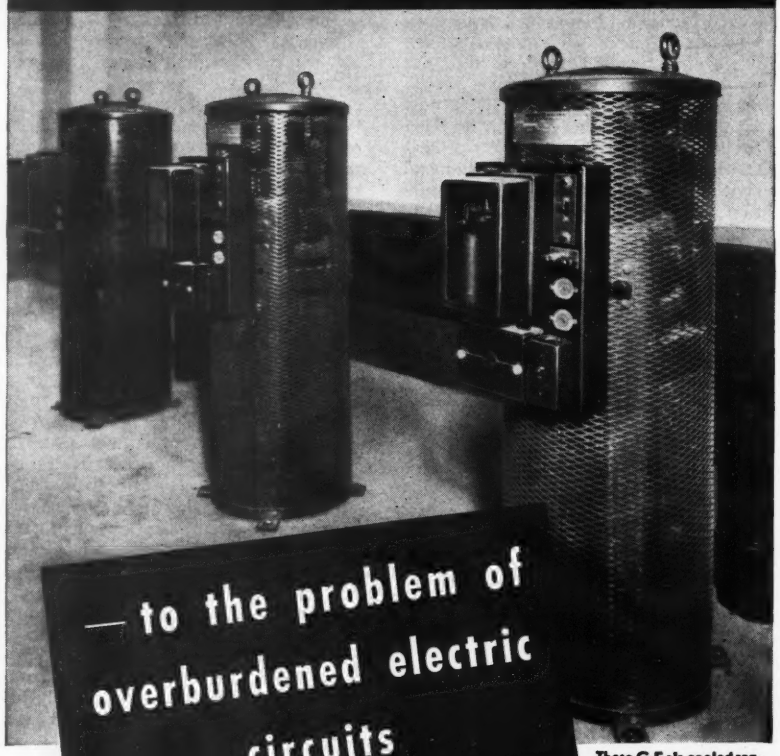
THE PROBLEM of R. L. J. who wants to know how to keep employees up-to-date in their field as well as interested in their work their employer's activities, etc., interests me because for some time I've been in the unique position of being a "putter-out" of a bit of material for such purposes, while being in the "hired-help" or "receiver" class at the same time.

To take a negative approach, nothing is so apt to dishearten an employee as much as having an outsider tell him about something new in his (the employer's) concern before he has heard about it "inside". This is the result of people in one department telling outsiders something new about their work (not in any sense confidential) which eventually gets back to the employees in another department. Obviously it could be avoided by a systematic means of disseminating information of inter-departmental interest. Confidential matter also leaks in the same way but that is a different problem, namely, one of finding employees who can keep their mouths shut when told to do so.

A company news service not only keeps employees familiar with goings-on in their concern but also stimulates their interest by making them feel their employer values it. Properly handled it can cover all the points mentioned by your correspondent. The extent of such a news service depends, of course, upon the amount of money available and large organizations often go so far as to publish weekly news papers and monthly magazines for employees. Others confine themselves to a few pages of mimeographed material while some do nothing. This last is hazardous not only because it indicates a peculiar personnel policy but because information then gets around by word of mouth, very often distorted and misinterpreted. Still other concerns make a stab at broadcasting news by holding lectures by members of various departments who try to tell those in other departments what is happening. This would not be feasible in a concern of any size for it would be necessary to hold the same talk several times to cover everyone and probably little of the information would sink in anyway.

Company news letters or bulletins, should be issued periodically at least once a month. This causes the readers to expect it and in time, if it is made interesting, look for it. In starting such a bulletin in a small company it would seem best if it were confined at first to reports of sales, news of laboratory activities and research programs (where not confidential), brief discussions on the state of business as affecting the company, references to worthwhile pertinent articles in trade journals and a calendar of important events. Later it could be broadened in scope to include personal items such as promotions and transfers, reports on sports and social activities if any, guest editorials by executives, abstracts of the more important magazine articles, and technical book

Here's the ECONOMICAL ANSWER



— to the problem of overburdened electric circuits

These G-E air-cooled regulators assure proper voltage on a lighting circuit in mill of Hanes Hosiery Mills Company, Winston-Salem, N. C.

IF YOUR motors are sluggish—if your lights don't seem to have the brilliance they should, then the chances are your power-distribution system has a bad case of undervoltage. And it's ten to one that the most economical, effective remedy is to install one of our new industrial-type voltage regulators.

These regulators—Type AIRS—automatically maintain the proper voltage, thus keeping lamps and motors operating at peak efficiency and contributing to increased production.

Type AIRS regulators are easy to install—they're air-cooled and require no fireproof enclosing vault. You can put them anywhere, even on overhead platforms if floor space is at a premium. They're available for circuits from 120 to 600 volts, in ratings from 1.2 to 12 kva.

Ask your G-E representative for complete information or write today for Bulletin GEA-3057. Address General Electric, Schenectady, N. Y.

A Few of the Industries Already Using These Profit-building Regulators

Oil refineries	Testing laboratories
Chemical plants	Construction contractors
Foundries	Glass manufacturers
Oil pipe lines	Radio manufacturers
Radio stations	Refrigerator manufacturers
Lamp manufacturers	Valve manufacturers

Special AIRS regulators can be used to control current, temperature, or any other variable which can be made to depend upon voltage.

GENERAL ELECTRIC

413-6

reviews (easily obtained from the publisher's ads).

Part of one man's time would suffice to put out a monthly bulletin of a few mimeographed pages for a starter. He should have the run of the shop, labs, etc., and the various department heads should be told to talk freely to him and encourage his repertorial activities. His personality must be such that he can talk with "bosses" and "help" equally well. His copy must of course receive executive scrutiny and approval before it is released so everyone is protected even though department heads should let slip something they were told is confidential.

In engineering and manufacturing concerns the business departments should not be overlooked and an effort should be made to include some abstract, note, or reference of interest to them.

THE SUGGESTION BOX

Much has been said for and against the "suggestion box" as a means for employees to express their ideas and possibly win a small prize. If such a scheme is in use the news bulletin would be a logical place to announce accepted contributions.

In small companies round table discussions among department heads, foremen, squad bosses, etc., are another method of stimulating interest and often offer a pleasant means of ironing out inter-departmental friction. The news bulletin can serve as the medium for bringing interesting high lights of such chats to the rest of the organization.

Aside from a news bulletin there are a few other things which should be considered. First, an organization chart so that employees, especially new ones, can determine who bosses who and how they fit into their employer's design for living. (Once, during a brief sojourn at a chemical company I found I had been talking back to a "laborer" who was merely the works chemist.) Second, if practical, some form of flow sheet should be drawn up to show, in general, what happens to an order from the time it is received until it is completed and shipped. That, of course, applies almost exclusively to manufacturing plants.

Manufacturers of heavy machinery and similar products should arrange inspection visits, if at all practical, to give the employees who have designed and built the equipment a chance to see it in operation.

It hardly seems necessary to mention that a representative supply of trade periodicals and occasional worthwhile new texts relating to the business should be on hand.

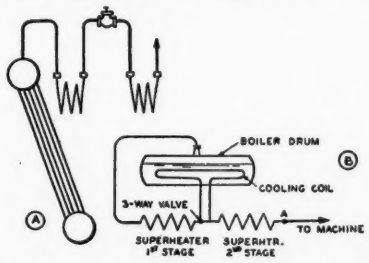
R. C. R.

EDITOR'S NOTE: The article "— its up to the management" on page 70 of the March issue is also a direct answer to this same question. Closely related to this is educational and apprenticeship programs and a number of publications available on these are listed in Misc. 229. available from the Vocational Div., Federal Security Agency, U. S. Office of Education, Washington, D. C.

Superheaters

WHAT IS meant by two stage superheaters and interstage desuperheating?
Chicago, Ill. E. N.

Two stage superheating might mean anything but in connection with the second question we interpret the first to mean superheaters made in two sections of different metals. Alloys suitable for extremely high temperatures are expensive and to reduce the cost the first or primary section may be made of ordinary steel and the second section, subject to high temperatures, of alloy steels.



By desuperheating between these two stages the high temperature section is further protected against excessively high temperatures. Two methods of doing this are used as shown by the drawings. At A a spray is used, at B a portion of the partially superheated steam is bypassed through coils submerged in the steam drums. Control in either case is by means of a thermostatic controlled valve with the sensitive element at the outlet of the second stage.

The two stage superheaters have been used in this country but the interstage desuperheater is, we believe, used only in Europe. However, both the spray and drum coils are or have been used in this country for control at the outlet of the superheater. For several other methods of superheater control used in this country see p. 398 of July, 1937, issue.

Luminous Flame Firing

"WE HAVE several large boilers fired with natural gas by forced draft Peabody burners. What I want to know is something about firing natural gas, and whether it is practical to carry a luminous flame. Will we lose any of our boiler rating?"

P. J. F.

"THIS QUESTION in regard to the desirability of operating gas burners firing a steam boiler in such a manner as to produce a luminous flame is very interesting. Of course the heat transfer by direct radiation from the flame body is dependent on the flame temperature and the emissivity of the flame. It is also true in general that if two flames have the same shape and are at the same temperature, a luminous flame will have a greater emissivity and will radiate at a higher rate than a non-luminous flame.

"However it usually is the case that when you get a luminous gas flame, you also get a lower flame temperature even if the excess air happens to be the same in each case, and any increase in radiation you might get due to increased luminosity is more than likely to be overbalanced by the decrease due to the lower flame temperature. As with all other conditions the same, the rate of heat transfer from the hot surface to the heat absorbing surface is a function of the fourth power of the difference in temperature between the radiating body and the heat absorbing body, it will be seen that a small change in temperature of the flame will make a great difference in the radiation rate.

"The hall mark of a first class burner for gas firing is generally accepted as being its ability to operate with low excess air and with a non-luminous flame, because luminosity with gaseous fuels is generally evidence of incomplete mixture of the fuel and air and usually is accompanied by incomplete combustion. However, if the furnace is large enough and there is enough air leakage into it, it may be possible to burn the fuel completely before it enters the heating absorbing surfaces. It generally is the case therefore that trying to operate with flame luminosity when firing gas is likely to be less economical than if the flame is non-luminous.

"If a burner is constructed so that it is possible to obtain a non-luminous flame only by the use of great amount of excess air, it is possible that luminosity might be advantageous. However, the endeavor of most manufacturers of gas burners for boiler firing is to build a burner which will operate with a non-luminous flame and with low excess air so as to produce a flame of the character of that produced by a Bunsen Burner in order to obtain rapid and complete combustion and a high flame temperature. Our experience in building burners for such service for a good many years has confirmed the theoretical conclusion that luminosity is not advantageous or in most cases even to be desired when firing steam boilers with gaseous fuel.

"However, in certain metallurgical furnaces of high flame burst temperature is not desirable as the metal may be burned, and a slow burning flame is more acceptable. Also, it is generally desired to run with a slight air deficiency in order to avoid metal losses by oxidation. This has resulted in the adoption to advantage in certain cases of what might be called laminar combustion. In this a sheet of gas is alternated with a sheet of air and the mixture between gas and air takes place rather slowly. This avoids a high flame temperature, creates a long lazy luminous flame, and gives a more even temperature over the metal bath, which is generally heated in a furnace quite long compared with its width.

"Anyone who had had a good deal of experience with metallurgical furnaces might thus easily fall into the error of assuming that the use of some such method of fuel-air mixture to produce a luminous flame would be equally advantageous in the case of firing boilers."

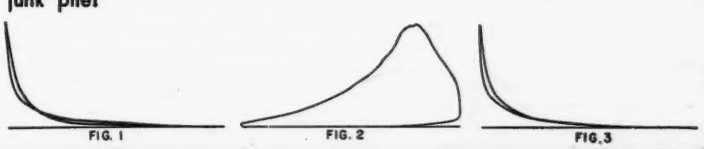
R. C. VROOM
Chief Engineer
Peabody Eng. Corp.
New York, N. Y.

NO INDICATOR EXPERTS? WE DON'T BELIEVE IT

EVIL DAYS are upon the engineering profession and the Old Timers who used to brag that they could read an indicator diagram like a book must be turning over in their graves. An indicator problem published on page 544 of the August issue has remained unanswered for seven months. Perhaps the Diesel application threw some off the scent, perhaps the problem wasn't worded properly and again it may be that there are no more indicator experts. An indicator does make a dressy bit of local color for the office but it's no real good if it's not used.

Just in case the original question was overlooked it is repeated below. The experts have had their chance and missed so it's perfectly proper for the amateurs to have a try at solving the mystery. These cards were taken from a three cylinder, two cycle Anderson Diesel pulling about ¾ load. Cards were taken from No. 2 cylinder with a 400 lb. spring and have been reduced to 0.55 the original size. The reducing motions are eccentrics on a layshaft driven at crankshaft speed by a silent chain. Card 1 is the conventional diagram; Card 2 is from the same cylinder but using the reducing motion from one of the other cylinders. Card 3 is a new one similar to No. 1 but taken after changing the reducing motion eccentric 14 deg.

The engineer who produced these freaks, and with our own indicator too, has lost faith in our diagnosis and we've lost faith in his measurements. What's wrong? He says, "the cards perhaps should be sent to Ripley instead of to you." Maybe he's right but we'd like a little help before he gets mad and throws our indicator out on the junk pile!

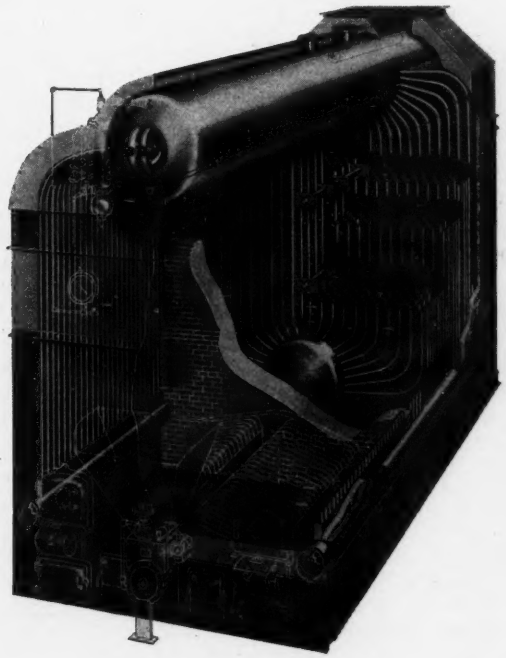


VISCOSITY INDEX CHART
for
LUBRICATING OILS
By
E. M. SIMS
VISCOSITY INDEX
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
EXAMPLE
Viscosity at 100 deg. F., 700 ssu
Viscosity at 210 deg. F., 67 ssu
From chart—Viscosity Index is 70
KINEMATIC VISCOSITY IN CENTISTOKES AT 100° F
VISCOSITY IN SAYBOLT SECONDS AT 100° F
VISCOSITY IN SAYBOLT SECONDS AT 210° F
KINEMATIC VISCOSITY IN CENTISTOKES AT 210° F

$10180 Saved In Two Years

Such is the experience of one user of a KEELER C P Steam Generator. The unit that made this saving consists of a 300 H. P. Keeler C P steam generator fired by an underfeed stoker that was formerly used under a water tube boiler of conventional design. The new boiler has more than paid for itself in a period of two years. *Name supplied on request.*

400 Units Sold in United States and Canada in Less Than Five Years



The One and Only C P Steam Generator. Originated by E. KEELER CO. Patented in U. S. and Canada

Sizes 50 H. P. to 1000 H. P.
Pressure to 450 Lbs.

Manufactured in Canada by Canadian Vickers, Ltd., Montreal

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Piston and Jacket Temperature Measurement

Piston and cylinder temperatures are influenced by a large number of factors including jacket water, oil and air temperatures, design factors, load and speed. The effects are not the same for different engines and the actual temperatures can be obtained only by measurement which involves difficulty at high speeds. Some of the methods used successfully are described

ENGINE OPERATING reliability depends largely upon effective temperature control of vital parts, particularly the piston, cylinder wall and rings. Because it is moving at high speeds, temperature measurements on the piston, or connecting rod, is difficult and several methods developed by different companies were described in a Symposium on Piston Temperatures held by the S.A.E. in Detroit.

Up to speeds of 1000 r.p.m., C. G. A. Rosen, Caterpillar Tractor Co., used the arrangement shown by Fig. 1. The iron-constantan thermocouple junction was placed behind the top piston ring groove and imbedded in the aluminum casting. The cable was fabricated as illustrated in Fig. 2 by winding the thermocouple wires over a soft core and wrapping spirally selected composite materials to provide sufficient flexibility to withstand breakage of the leads by bending. The terminal block on the crankcase was connected to a L & N continuous recording potentiometer. The knee joint mechanism provided a guiding conduit to dampen the whip of the cable.

For higher rotated speeds, approaching 2000 r.p.m., he used the apparatus shown by Fig. 3, in application to connecting rod bearing temperature determinations. The thermocouple contacts are mounted on the connecting rod bearing cap and are so arranged that on the down stroke of the piston they sweep through a set of contacts mounted on the case. In the sketch these contacts are shown closed, the condition when the rod is on the upper portion of the stroke. Under this situation, the dry cell and variable resistance impress a voltage on the potentiometer and oscillograph, depending upon the position of the pointer on the variable resistance.

As the rod goes through the lower portion of the stroke, the rod contacts spread the case contacts, breaking the circuit described above. A new circuit is established by the rod thermocouple. The temperature at that point induces a voltage on the potentiometer and oscillograph which, if different from the voltage impressed by the dry cell, will show as a break in the oscillograph diagram. By moving the pointer on the variable resistance, the voltage from the cell and that from the thermocouple can be made identical. This condition is indicated when the oscillograph shows a continuous line. The temperature of the rod bearing can be read at this time from the potentiometer. Piston temperatures can also be obtained by this method when the thermocouple is located in the piston structure.

L. A. Wendt and T. B. Rendel, Shell Petroleum Corp., used the continuous reading arrangement suggested by Mr. Rosen and found it possible to operate 20-30 hr. at 1200 r.p.m. without failure of the cable.

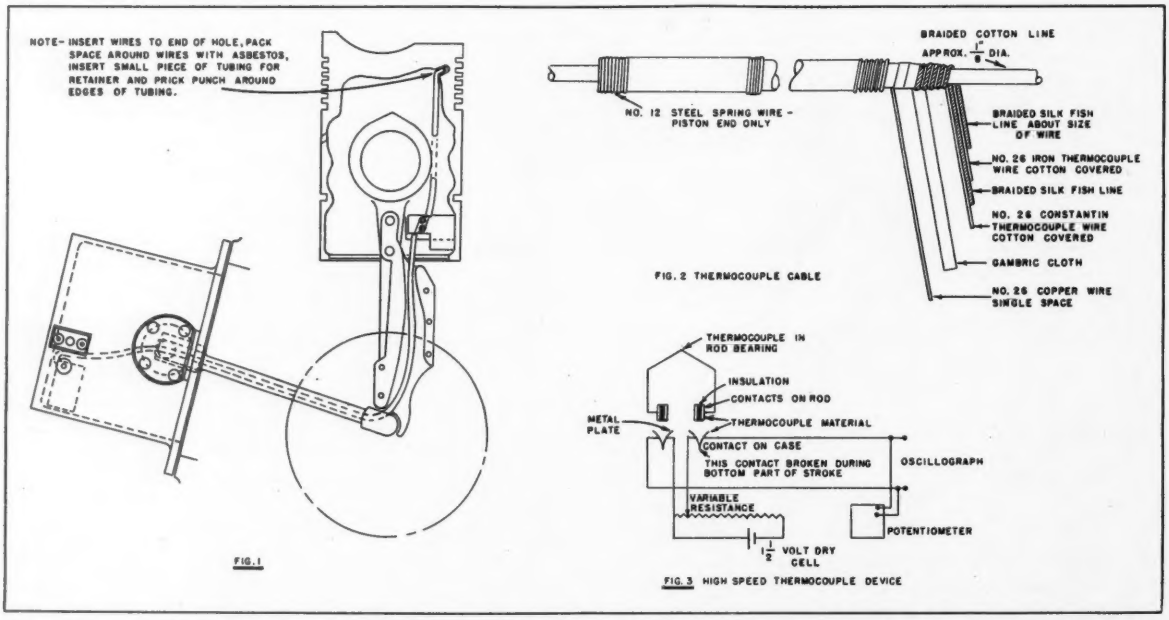
NOTE- INSERT WIRES TO END OF HOLE, PACK SPACE AROUND WIRES WITH ASBESTOS, INSERT SMALL PIECE OF TUBING FOR RETAINER AND PRICK PUNCH AROUND EDGES OF TUBING.
FIG. 1
BRAIDED COTTON LINE
APPROX. 1/8" DIA.
NO. 12 STEEL SPRING WIRE - PISTON END ONLY
BRAIDED SILK FISH LINE ABOUT SIZE OF WIRE
NO. 26 IRON THERMOCOUPLE WIRE COTTON COVERED
BRAIDED SILK FISH LINE
NO. 26 CONSTANTIN THERMOCOUPLE WIRE COTTON COVERED
GAMBRIC CLOTH
NO. 26 COPPER WIRE SINGLE SPACE
FIG. 2 THERMOCOUPLE CABLE
THERMOCOUPLE IN ROD BEARING
INSULATION
CONTACTS ON ROD
METAL PLATE
THERMOCOUPLE MATERIAL
CONTACT ON CASE
THIS CONTACT BROKEN DURING BOTTOM PART OF STROKE
OSCILLOGRAPH
VARIABLE RESISTANCE
POTENTIOMETER
1 1/2 VOLT DRY CELL
FIG. 3 HIGH SPEED THERMOCOUPLE DEVICE

Fig. 1. Arrangement of cable for continuous indication of piston and ring temperatures for speeds of up to about 1000 r.p.m. Fig. 2. Construction details of a special thermocouple cable for use with the arrangement shown by Fig. 1 and with a high resistance to flexing fatigue. Fig. 3. Wiring diagram of an arrangement used for high speeds temperature measurements on moving parts, the moving parts contact the stationary parts only at the bottom of the stroke

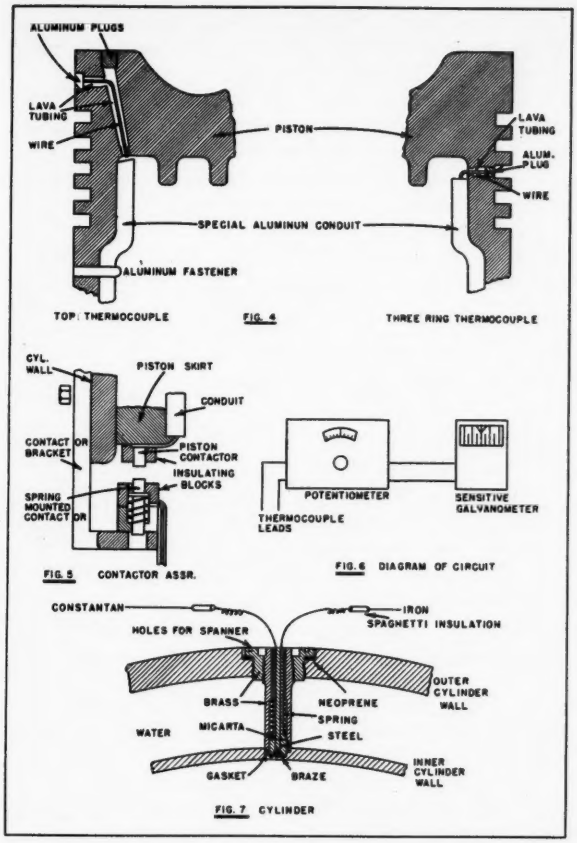

Fig. 4. Methods used for installing and insulating thermocouples in pistons and behind rings. Fig. 5. Arrangement of stationary and moving contactors for taking piston temperature measurements. Fig. 6. Diagram of circuit used with the contacts shown by Fig. 5. Fig. 7. Construction and installation of thermocouple for measuring cylinder wall or liner temperatures

For measurements of piston temperature they located a thermocouple $\frac{1}{16}$ in. back of the bottom of the top ring groove in that area of the piston which receives the hot blast of burning gases emerging from the separate combustion chamber. The junction of the iron and constantan thermocouple wires was held in the piston by means of a hollow retaining screw; the wires were insulated with two-passage porcelain tubing. Positive metal-to-metal contact between the junction and the piston was assured by a small amount of mercury held in place by asbestos packing.

From the junction, the lead wires were brought down the inside of the lower skirt to a junction block where they joined the flexible cable. The block was made of aluminum and was carefully fitted to the piston; anchor screws passing through the block into the boss of the piston held it in place. The boss was fitted with steel inserts for the anchor screws to prevent stripping of the threads in the aluminum piston. Connections between the thermocouple leads and the cable were made in fibre plugs screwed into the aluminum block.

The cable, Fig. 2, was made by mounting the core between centers and turning very slowly as the iron and constantan wires, spaced by fishing cord of the same diameter as the wire, were wrapped on the core. The spools containing the wire and cord were mounted free to rotate, 2 ft. below the cable, the wire and cord were guided by hand as the cable rotated.

A single thickness of $\frac{1}{4}$ in. wide cambric cloth was wound over the wire and finally an armor of enameled copper wire was wound over the cambric cloth. Four inches of the end of the cable attached to the junction block were further protected by a coil of steel spring wire. This coil spring was made separately so that its inside diameter equaled the outside diameter of the cable, and then pushed onto the end of the cable. This provided support for the cable where the flexing bend was of small radius.

Design of the cable carrying linkage was such as to limit the amount of cable flexing to a minimum. The principal parts were a vertical member which guided the cable in the vertical plane and a horizontal member which carried the cable to the modified side plate of the engine. In order that these members could be installed in the engine, it was necessary to mill about $\frac{3}{16}$ in. off the side of the connecting rod and to redesign the wrist pin bushing so that the vertical arm could pivot about the pin. The reduction of the weight of the rod partially compensated for the added weight of the reciprocating linkage and maintained a fair degree of balance; during more than a year of operation there have been no rod failures.

Side plates riveted to the vertical arm, together with the fibre spacing piece, served to keep the cable in line during operation and controlled the arc formed in the cable at the junction of the vertical and horizontal arms. The engine side plate end of the horizontal arm pivoted on a hangar shaft which was mounted in the box-like projection welded to the side plate.

After the cable passed through the horizontal member, it was carried through the side plate box and held firmly by a clamp mounted on the box. Before starting the engine, after the apparatus had been installed, it was necessary to adjust the tension of the cable carefully. This was accomplished by turning the engine over by hand with the cable clamp released; sufficient tension was maintained on the cable by hand so that the minimum amount of cable required for free turning was determined, then approximately $\frac{1}{4}$ in. more cable was allowed for ample clearance and the cable clamped. If the cable is too tight, it will be pulled apart and if too close, it will whip excessively, causing early failure because of fatigue of the iron and constantan wires.

The method of piston temperature measurement used by P. V. Keyser, Jr., Socony-Vacuum Oil Co., was of the movable contact type suggested by General Motors. The general design and installation of the system are shown diagrammatically in Figs. 4, 5 and 6. The thermocouple in the piston is connected to contacts on the bottom of the piston. These contacts mate with spring loaded contacts attached to a bracket on the liner. The contacts in each case are made of the same type of metal as is the leg of the thermocouple it connects. The springs loading the movable contacts are of spring steel and as there is little or no temperature drop across the spring, it is believed that no error is incurred through the insertion of this third metal.

Lava tubing insulates the wire from the piston until the wire reaches the interior of the piston. The wires are then wrapped with mica tape and inserted in an aluminum conduit which is riveted to the piston in several places to prevent vibration of the wires. Wires are soldered to the contacts, likewise the wires connecting the potentiometer to the movable contacts are soldered to the springs. A duration of contact of 35 deg. of crankshaft angle has been found to give ample sensitivity of temperature measurement with the instruments employed. As many as three thermocouples have been used at one time.

Cylinder wall temperature measurements made by Mr. Keyser employing the cylinder wall thermocouple design shown in Fig. 6, was arrived at after several other types had been tried for care must be exercised in the installation of the thermocouple to prevent cylinder wall distortion. Several distances of the thermocouple from the inner wall were tried, including the embodying of the thermocouple flush with the inner wall. It was found that a distance of about 0.040 in. from the inner wall gave, as far as could be determined, a thermocouple that was just as sensitive as the one which was flush with the inner wall.

Sidney Oldberg, Chrysler Corp., in making measurements placed the thermocouple junctions $\frac{1}{16}$ in. below the upper surface of the piston head, $\frac{1}{16}$ in. below the top ring groove and $\frac{1}{16}$ in. below the lower oil ring groove. The leads were brought to an insulating block through contacts projecting below the piston skirt which contact distributor breaker points at the bottom of the piston motion for about 20 deg., then through a selector switch to a potentiometer having a sensitive light-beam galvanometer.

Since the thermal lag of the points measured insures constant temperature throughout the cycle, the potential at the contacts remains fixed. If the usual null method of potential measurement wherein the galvanometer receives current only for 20 deg. of the 360 deg. when the bridge is not balanced, which requires a highly sensitive galvanometer. He said the method is used without difficulty at 2400 r.p.m. and is probably capable of much higher speeds. The method is reproducible to less than plus-or-minus 3 deg. and only shorting of the thermocouples can produce any error.

In piston temperatures measurements by the Air Corps, iron and constantan wires from the center of the piston head are led to contact pins of similar metals, rigidly attached inside the piston skirt. These pins contact similar metal springs when the piston is at the bottom of its stroke. While this contact is made for less than $\frac{1}{16}$ in. of piston travel, it is sufficient to balance a null type potentiometer.

Preliminary Air Corps tests indicated that such momentary contacts give accurate readings up to 4000 contacts per minute. The only difficulty with this arrangement was mechanical, for it is difficult to prevent breakage of the contact springs. Use of a cam which moves the springs out of reach of the contact pins on the piston, except when taking readings, greatly prolongs the running time before breakage.

Valve temperatures were also obtained by iron-constantan thermocouples. A constantan wire was led through a hole drilled along the axis of each valve stem and was welded to the valve head. A small porcelain tube insulated this wire from the stem, and the wire was led out of the stem at the neck which retained the spring keepers. The usual steel wedge spring retainers were replaced by Bakelite retainers, which acted as insulators for the constantan wire.

At the side of the stem opposite to which the wire was led out, an iron wire was welded on. These two wires, which constituted the iron-constantan leads were coiled in "pig tails" and joined to stranded leads.

The Midwest Power Conference

Continued from Page 68

lost a single soot blower element. An average of 15.31 per cent CO_2 had been maintained.

Well, there were the figures, you could believe them or not, but Mr. Moe's evidence was quite conclusive. He described exactly how he managed to produce such a remarkable record, though in this he was sadly hampered by the inability of the stereoptician to accommodate the charts which he intended to project on the screen. This annoyed him visibly and no doubt justly since he said he had been told that the projector would accommodate his charts. Trivial annoyances such as this often cause considerable disturbance, emotional and otherwise.

It is not possible in a brief report such as this to refer even briefly to all the technical papers presented at the conference. The papers were quite diversified, however, and there was something of specific interest to practically everybody. None of the papers was so specialized, however, as to preclude interest in them by those not immediately associated with the specific branch of the art covered by the paper.

There was one session devoted to electrical transmission and another to power processes. Fuel problems of power plants and hydro plants were discussed at two separate simultaneous sessions. Philip Sporn at the electrical transmission session described modern practice in the protection of high voltage transmission lines. At the same session P. J. Juhnke of the Commonwealth Edison Co. revealed the intricacies of load dispatching on a large system.

An interesting paper at the Fuels session was one by H. A. Kleinman of the Peoples Power Co. at Moline, Ill., on the intermittent burning of gas and pulverized coal. This is a problem of importance in plants where gas is burned on an "interruptible" basis but, as described by Mr. Kleinman, with proper technique the two fuels can be burned effectively and efficiently simultaneously or alternately.

On the whole, the conference was of considerable general interest and to us it seems that therein lies its chief value. By providing engineers in each branch of engineering with a general idea of what the other branches are doing makes for closer and better understanding and cooperation throughout the engineering profession as a whole.

Quick Starting Turbines

From a cold start to carrying load in 15 sec. is just one of the conditions that must be met by emergency house turbines in a modern station. Requirements, present practice and control details in contemporary plants are outlined in this article to show what can be expected of quick starting emergency equipment.

By J. T. MOFFETT
Turbine Engineering Dept.,
General Electric Co.,
Schenectady, N. Y.

EMERGENCY SHUT-DOWNS would play havoc with power plants if there were no provisions to handle load and get stations started up again. Picture the situation if a large power plant were confronted with an emergency in the middle of the night and had to be started up again in total darkness! One of the best safeguards against just such situations is the emergency house turbine. Basically, turbines of this type are no different from other turbines except for their specialized control and their ability to take load from cold in a matter of seconds. While this is a small difference, it is an important one.

There are two types of emergency house turbines: the quick-starting and the spinning turbine. Each is suited to a particular set-up of power station or industrial plant. Quick-starting turbines have been started cold, and in 15 sec. or less attained full speed with full voltage on the generator, ready to take load. Spinning turbines, as the name implies, are kept up to speed, and can assume any load within capacity in less than four seconds. In both types, efficiency is of secondary importance because the turbines are designed for emergency use and carry load only for short periods. Tests on a 4000 kw. emergency house turbine installed at one of the Southern California Edison plants have shown that it can be started cold and will carry load 13 sec. after the starting button is pressed.

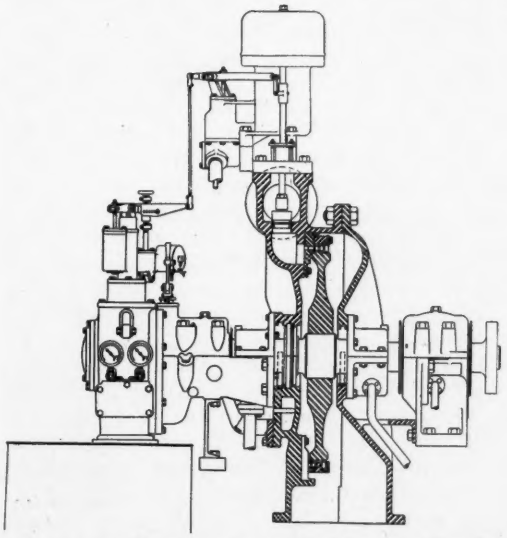

Fig. 1. Typical cross section of an emergency house turbine

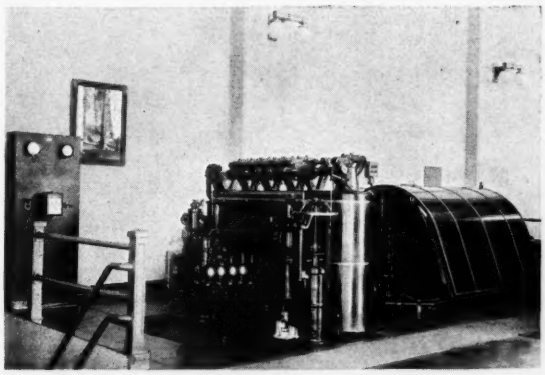

Fig. 2. A 4000 kw. emergency house turbine installed in the Long Beach Station of the Southern California Edison Co.

An emergency set is kept spinning all the time in Station P of the Pacific Gas & Electric Company in San Francisco. The station is tied in with the power system. Should the system frequency drop, the main set in the station picks up its load and the emergency house turbine is automatically cut loose from the system. It then carries the auxiliary load at nearly normal speed, independent of system conditions. The quick-starting turbine is operated non-condensing to simplify the equipment and avoid the difficulty of attempting to have condenser and auxiliaries functioning in such a short time. It is possible to connect to a condenser of another operating unit with a quick opening valve in the line, but the complication of this practice is not worth while except in unusual cases.

Spinning turbines are operated with a vacuum held in the casing so that no steam will have to be admitted to the turbine for cooling purposes. A steam seal is provided for the packings only. The vacuum in the casing is obtained by piping the exhaust to the condenser of some other unit in operation, generally the main generating set. This vacuum reduces the rotation losses of the turbine and the power input to the generator, which is used for power factor correction during this operation.

Bypass Connection to Main Condenser

Vacuum is held in the casing of the Pacific Gas & Electric spinning-turbine by a bypass connection

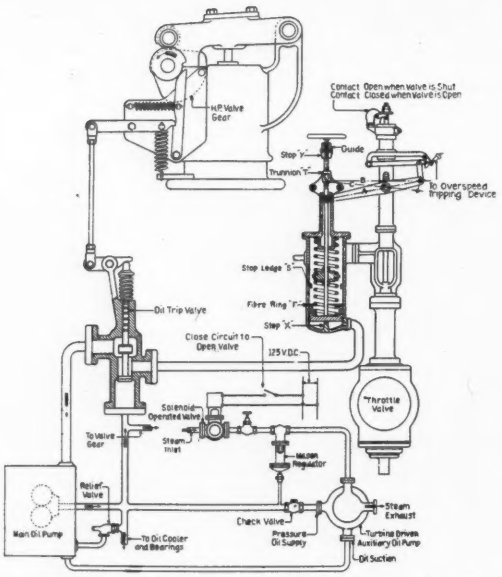

Fig. 3. Governing oil diagram for emergency house turbine suitable for either quick starting or spinning

to the condenser of the main set. When carrying load, the bypass line is closed and the turbine operates non-condensing, exhausting to atmosphere The governing mechanism is adjusted so that the governing valves will admit sufficient steam to carry ¾ load at the normal frequency of 60 cycles. The throttle valve is closed, shutting off steam to the turbine, and the set is operating as a synchronous condenser.

When the system frequency drops, the oil trip valve shown in the diagram Fig. 3 is unlatched by the valve gear movement. Only 1.5 sec. are required for the hydraulic cylinder to open the throttle valve, and steam is admitted to the turbine. As the unit picks up its load, reverse power relays act to open an oil circuit breaker separating the service bus from the system. The adjustment of the governing mechanism requires only a small drop in frequency to cause the turbine to assume full load.

Where the turbine operates non-condensing under load, the line to the condenser can be small. A quick closing valve in this line closes when steam is admitted to the turbine, and the steam goes to atmosphere through a relief valve. In cases where good make-up water is difficult to obtain, it is desirable to condense the steam. This, of course, requires a bigger exhaust line to the condenser. Cost of piping can be kept low by the use of higher than the usual steam velocities. The pressure drop through this pipe might be such that the pressure at the turbine exhaust at full load would approach atmospheric pressure.

Control of a quick-starting turbine consists mainly of the standard speed governing mechanism made up of a centrifugal speed governor, an oil relay, and spring-loaded hydraulic cylinder for controlling the governing valves, with the addition of and a combined trip and throttle valve with a spring-loaded hydraulic cylinder for opening the valve. The throttle valve is closed either by loss of oil pressure in the cylinder or by tripping the turbine emergency governor. The main oil pump is driven directly from the turbine shaft. To obtain oil for starting and stopping, there is a separate, turbine-driven, auxiliary oil pump with a pressure regulator and a solenoid operated valve in the steam inlet line. There is also a relay to close the generator field circuit.

Solenoid and relay can be energized in a number of ways, such as by a low-frequency relay, a low-voltage relay, a push-button station, or by closing a switch on a circuit breaker. With the opening of the solenoid valve, steam is admitted to the turbine-driven auxiliary oil pump, and oil pressure is built up in the lubricating system and in the hydraulic cylinder, opening the governing valves. Before the throttle valve is opened, the governing valves are allowed to open to a wide-open position. Then a small valve is tripped open to admit oil to the cylinder on the throttle valve, and as this valve opens, the steam is admitted to the turbine. With the generator field circuit closed, excitation is applied to the generator from its direct-connected exciter as the unit accelerates. Voltage on the generator is built up almost to normal at full speed.

Interlocking Throwover Switch

The simplest arrangement for loading a quick-starting unit is to use an interlocking switch to throw the essential load on the turbine as it is disconnected from the main bus. No attempt would be made to synchronize the unit. With a field rheostat for both the direct-connected exciter and the generator, the exciter can be adjusted to deliver proper excitation voltage at full speed for full load on the generator. The generator field rheostat can be adjusted to reduce this excitation voltage to the collector ring voltage required for no load on the generator. When the unit comes up to speed and normal voltage is reached on the generator, the load is thrown on, the generator field rheostat is immediately shorted out by a relay, and normal voltage is delivered to the auxiliaries. This load transfer can be accomplished manually, or automatically by a voltage relay set to function when normal voltage is reached on the generator at no load.

There are two methods of controlling spinning-turbines. In one the throttle valve is closed and the governing valves are open; in the other, the throttle valve is open and the governing valves are closed. In the first method, the throttle valve is opened by a hydraulic cylinder. Oil is admitted to the cylinder by a small trip valve which can be opened mechanically or by a solenoid. In either case, the controlling medium of this oil trip valve could be the turbine itself. There would be a certain predetermined load which this generator set would be expected to carry under emergency conditions.

Let's assume that there would probably be a drop of one-half per cent in frequency when the emergency occurs. The governing mechanism is set so that the governing valves are open for the required amount to carry the predetermined load at this reduced frequency. At normal frequency, the governing valves would not be open so far. With the drop in frequency, these valves open up and actuate the oil trip

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valve by mechanical connections, or close a switch which energizes a solenoid to trip a similar valve. The drop in frequency for this changeover is sufficient to allow for minor variations which do not affect the operation of the station.

With the spinning unit, there can again be a field rheostat for both exciter and generator. The one for the exciter should be adjusted so the exciter voltage is that required for the generator under the predetermined load to be carried. The one for the generator should be adjusted so that the generator acts as a synchronous condenser for a limited amount of power factor correction. If a switch is used to energize the solenoid-operated oil drip valve, it can also actuate a relay to short out the generator field rheostat, provided the generator field current is less than required for the predetermined load, and the control of the unit is complete in itself. Control can be obtained from external relays, such as low frequency, low voltage, or a switch on a circuit breaker taking the place of the switch which is closed by movement of the valve gear.

For spinning-turbines where the throttle valve is open and the governing valves are closed, the simplest arrangement is a standard speed governing mechanism with the governing valves just closed at normal frequency. As the frequency drops, the valves will open, admitting steam to the turbine, and load will be developed. The greater the frequency drop, the greater the load developed. If the speed governor has a four percent speed change from no load to full load, full load would be carried at four percent lower frequency than normal.

Where the four percent drop in frequency for carrying full load is too great for proper operation of auxiliaries, the speed governing mechanism can be equipped with a suitable restoring mechanism that will give the speed governor a settled regulation of substantially zero. Then when the frequency drops sufficiently below normal to be out of the range of minor variations—possibly 0.5 percent—the governing valves will open and any load within capacity can be imposed on the unit and carried with no further decrease in speed.

With the standard speed governing mechanism, for a particular setting of the synchronizing device, there is a definite position of the governing valve gear for any speed. This can then be used for an indication of frequency, and a movement of the valve gear used to actuate either a mechanical trip or close a switch after a drop in frequency. This will accomplish any desired change in the setting of the governing mechanism. With the turbine spinning at normal frequency and the governing valves closed, the mechanism can be arranged to carry any predetermined load at a reduced speed, even if this reduced speed is as little as 0.5 percent below normal When this reduced speed is reached, the movement of the valve gear actuates a trip which mechanically adjusts the governing mechanism, or, by closing a switch, energizes a solenoid trip valve to accomplish this adjustment hydraulically by governing oil pressure. Here again the control of the unit in taking over the essential load is complete in itself. When desired, the solenoid trip valve can be energized by external relays.

When the spinning turbine carries an emergency load, its generator is disconnected from the main bus by a reverse power relay, leaving only the essential load connected to the emergency turbine generator set.

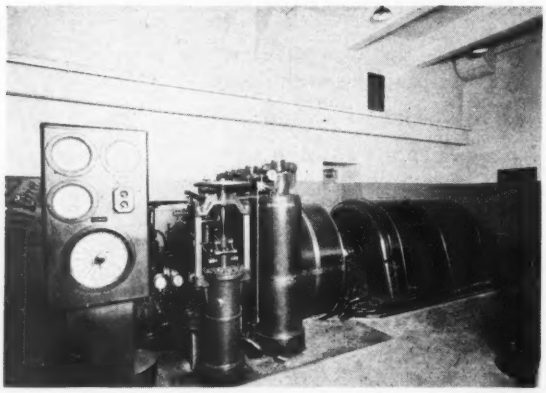

Fig. 4. A 2500 kw. emergency house turbine installed in the Shuffleton plant of the Puget Sound Power & Light Co.

Control Circuits

The most reliable source of power for electrical controls on spinning-turbines are d-c batteries. Circuits used may be open normally so there will be no drain on the batteries. The solenoids or relays function when the proper switches close, and actuate a trip which would be, hand reset, and a cut-out switch which opens the circuit. The only power taken from the batteries is the instantaneous inrush current of the solenoid coil. Hand reset trips prevent the unit from reverting to its normal operation until the station operator resets each trip in the proper sequence.

A 2500 kw. emergency house turbine at the Shuffleton Plant of the Puget Sound Power & Light Co. is arranged for both quick starting and spinning. In this plant there are two 35,000 kw. turbine generating sets as standby for hydro power. When the load on the plant exceeds about 20,000 kw., the emergency set is started up and operated spinning, motoring from the generator end. If anything happens to kick the main sets off the line, the drop in frequency causes the governing valve gear on the emergency turbine to trip open an oil valve mechanically. Oil is admitted to the hydraulic cylinder, opening the throttle valve and admitting steam to the emergency turbine. It then takes over the auxiliary load of the station.

The Southern California Edison Co. has three emergency house turbine driven generators arranged for either quick starting or spinning at its Long Beach Steam Station. For quick starting, a solenoid valve is energized by a push button switch to start the auxiliary oil pump, and the oil pressure opens the governing valves and throttle valve. Load is applied to the generator when it is up to speed by asystem of relays under control of one master relay. In this way the essential load is disconnected from the auxiliary generator driven in tandem with the main generator, and placed on the emergency set.

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THE LINK-BELT 2-ROLL SIZER

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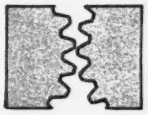
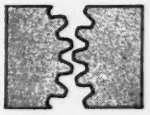
The pyramidal teeth on each roll of the Link-Belt chain-driven sizer are accurately meshed centrally with respect to each other, as illustrated below. This is not possible with gear-driven machines.

OLD STYLE GEAR-DRIVEN CRUSHER



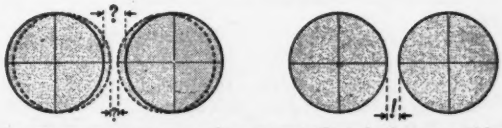
Note unequal spacing between roll-teeth as they mesh. This promotes degradation and oversize in the product.

LINK-BELT CHAIN-DRIVEN SIZER



Note equal spacing between roll-teeth as they mesh. This results in closer size-uniformity of the product.

The design of the Link-Belt chain-driven sizer permits placing the flywheel on the countershaft, with its consequent obvious advantages, instead of on one roll shaft as with gear driven crushers.



Link-Belt roll segments are ground to accurate fit and when assembled form a concentric roll. Visualize the effect of these rolls on the uniformity of the sized product as compared with inaccurately made segments, as illustrated above.

Check These Outstanding Features:

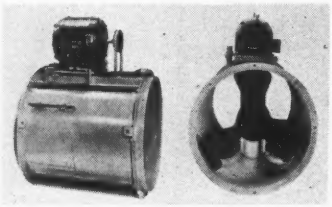
1. Simple, compact design, saves space.
2. Unbreakable all-welded steel frame.
3. Ease of adjustment of roll settings for sizes from ¾" to 8".
4. Smooth, quiet operation.
5. Low maintenance cost.
6. Less power for driving.

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Straight Line Exhauster

A NEW Straight-Line Exhauster, developed by the L. J. Wing Mfg. Co., 154 W. 14th St., New York, N. Y., is available in horizontal design or vertical; with belt drive which permits selection of any fan speed to fit any condition of air volume and resistance. This exhauster is equipped with Wing-Scruplex propeller fan which delivers large air volumes against duct or wind resistance. Location of motor outside the air duct keeps it clean and cool and reduces fire hazards when the air mixtures being exhausted are inflammable or explosive.



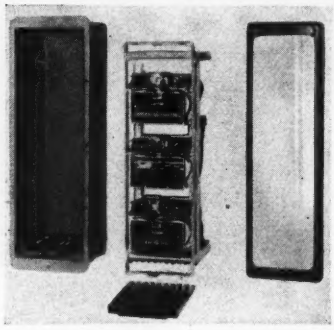
Purifying Unit

THE CENTRIFIX CORP., Cleveland, Ohio, has recently adopted Meehanite castings for many cast parts. The Centrifix tuyere unit in several models is now cast with the stainless steel tuyere blades cast directly into the tuyere casting. These purifying unies are used in steam, vapor, gas, and air lines in standard sizes ranging from 2½ to 12 in. and with working steam pressures from 125 to 250 lb. per sq. in. They operate upon gaseous fluids in motion, making use of the motion to accomplish the elimination. Operation is continuous and the units require no cleaning or maintenance. Units remove up to 99.8 per cent moisture and in the case of solids will leave not over nine parts per million carryover.

Drawout Relay

A "DRAWOUT" relay easily removable from the switchgear and combining in one unit the relay and testing devices heretofore mounted separately is announced by General Electric. This new relay consists essentially of three parts: (1) a case which can be mounted and wired permanently; (2) a self-supporting cradle that carries the relay elements and their terminals; and (3) a connecting plug that makes positive silver contact between the relay terminals and the studs in the case. It provides complete accessibility, simplifies servicing, saves panel space, and reduces wiring.

To draw out the cradle containing the relay elements the cover of the case is removed and the connecting plug withdrawn. This, in order, opens the trip circuit, short-circuits the current transformers, and disconnects the potential transformers. After the plug has been removed the cradle is easily unlatched and drawn out. It can then be replaced by another relay assembly which has been tested in the laboratory, or it can be serviced on the job. Withdrawn from its case, the relay is accessible from all sides, and yet protected by the cradle so that it may be laid on the work-table in any position. A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel.



Trap

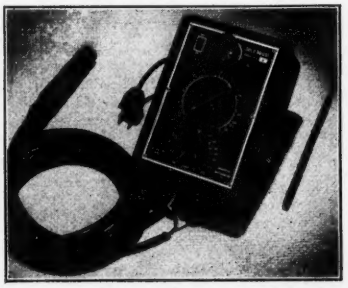
SOME TRAP. When a trap can carry away 195,000 lb. of water an hour at 10 lb. pressure, it may be considered of man size. This size was first used for draining evaporators in sugar refineries, but is now offered for use with large steam purifiers, separators, heat exchangers, blowdown systems and multiple effect feed water evaporators. It has a large Armstrong inverted bucket type pilot trap, and a piston-operated main valve which is installed as an elbow valve in the drain line. The pilot trap is connected to the drain line from a point above the main valve so that the latter is kept sealed. When the pilot trap is filled to the point of discharge, its discharge flows upward against the piston of the main valve, opening that valve. Quick closing takes place when steam enters the pilot trap.

Sledge-Type Wrenches

A COMPLETE series of these powerful sledge-type Boxocket Wrenches and companion sockets is available from the Snap-on Tools Corp., Kenosha, Wis. The anvil end takes the smashing blows of a sledge hammer as the bolts are tightened. The companion sockets are used where obstruction must be cleared or to reach buried bolt heads or nuts. These single hexagon wrenches are made in a complete series ranging in size from $1\frac{7}{16}$ to $4\frac{5}{8}$ in.

Solu-Bridge

INDUSTRIAL INSTRUMENTS, INC., 156 Culver Ave., Jersey City. N. J., announces a new addition to its line of "Solu-Brdige" test instruments, with a new model, known as Model RD-4. This bridge operates on the electrolyte conductivity principle. All that is necessary to operate the instrument is to connect it to a 110 v. 60 cycle outlet and dip the conductivity cell furnished with the instrument into the water to be tested. The indicator dial is then rotated until the shadow in the "magic eye" is at a maximum. Concentration in grains per gallon is then read directly on the dial. The instrument covers a range of from one to 500 grains per gallon and a temperature compensation dial, provided, covers a range of from 64 to 190 deg. F. The device has application in laboratories, industrial plants, boiler rooms and many other places where the quality of water is of importance.



Welding operations on a section of a high pressure-high temperature job in the shops of Power Piping Division.

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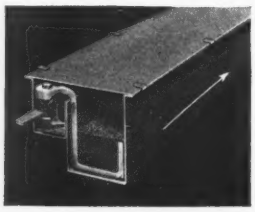
Redler Conveyor

NEW STYLE horizontal closed circuit Redler conveyor announced by Stephens-Adamson Mfg. Co., Aurora, Ill., features the driving chain moving a compartment separate and distinct from the

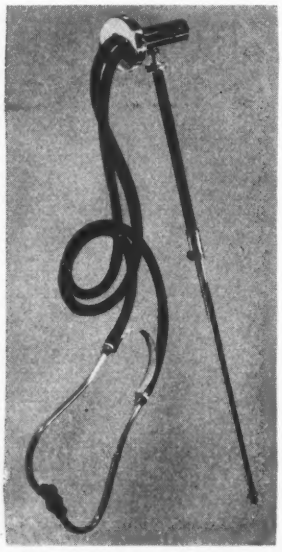


compartment handling conveyed material. This construction eliminates any metal to metal contact in the carrying run. Conveyed material is entirely free from the metal to metal contact of sprockets and chain, or chain and casing. The new design does not add to the overall width or length of the conveyor because of the

separate chain compartment; the addition in size of the casing is made on the inside of the circuit. It is available in either the 90-deg. or 180-deg. type horizontal closed circuit Redler. In the 90-deg. type, there are four corners, each curved at 90-deg. angles. In the 180-deg. type, the circuit is made with only two curved corners, each 180-deg.

Test-A-Tone

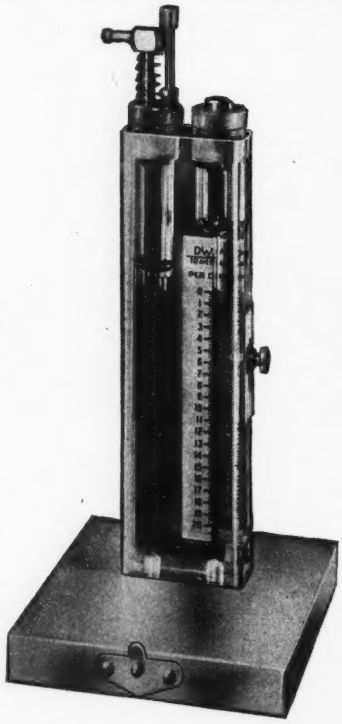
THE TEST-A-TONE made by the Test-A-Tone Co., 274 Madison Ave., New York, N. Y., is literally an engineer's stethoscope. Though non-electric, the Test-A-Tone is equipped with volume control which can be adjusted to reduce transmitted sound to desired strength and



eliminate brackground noises. It is used in spotting incipient or existing trouble in steam plants, combustion engines, compressors, steam traps and similar equipment.

CO_2 Indicator

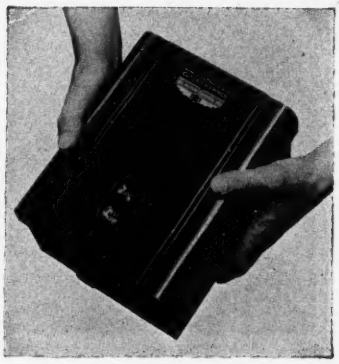
A NEW CO_2 Indicator made entirely from a crystal clear transparent plastic material is announced by the F. W. Dwyer Mfg. Co., 565 W. Washington Blvd., Chicago, Ill. It is not a molded product but machined and bored from a



solid block insuring close accuracy and great strength. Notable features are the corrosion proof monel fittings, carrying case with built in compartments for draft gage and thermometer, and self closing valves. Making the rubber tubing connection is the only set up required. Analyses are run rapidly by holding the inlet plunger down while pumping the sample in and raising and lowering the absorption unit. Each charge of absorbent solution is good for at least 500 tests.

Line Starter

CUTLER-HAMMER, INC., Milwaukee, Wis., announces a number of improvements in Bulletin 9586 Across-the-Line Starter for the control and protection of polyphase squirrel cage motors up to 5 hp. The streamlined, simplified, hook-on cover, held by one fastening screw, permits group panel mounting with minimum clearance between adjacent starters. The interior of the case is finished in light aluminum to facilitate wiring and inspection in poorly illuminated locations. Loosening one screw permits removal of the operating mechanism for easy wiring and conduit work. The contacts—dust safe vertical—are made of much heavier "fine" silver. Lava insulators protect contact springs against even

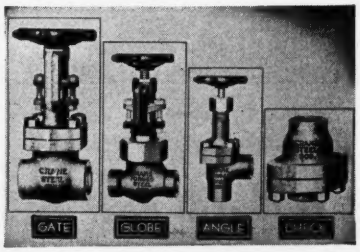


minor heat transmission. For protection against rust, the contact springs and contact supports are made of stainless steel—all other metal parts are cadmium plated. This starter is available in the following types of cover control: Reset only for 2 or 3 wire remote control; start and stop reset buttons for 3 wire control; and three position selector switch for manual-off-automatic local control or 2 or 3 wire remote control. The starter can be obtained in open panel type for cavity or built-in mounting.

Small Steel Valves

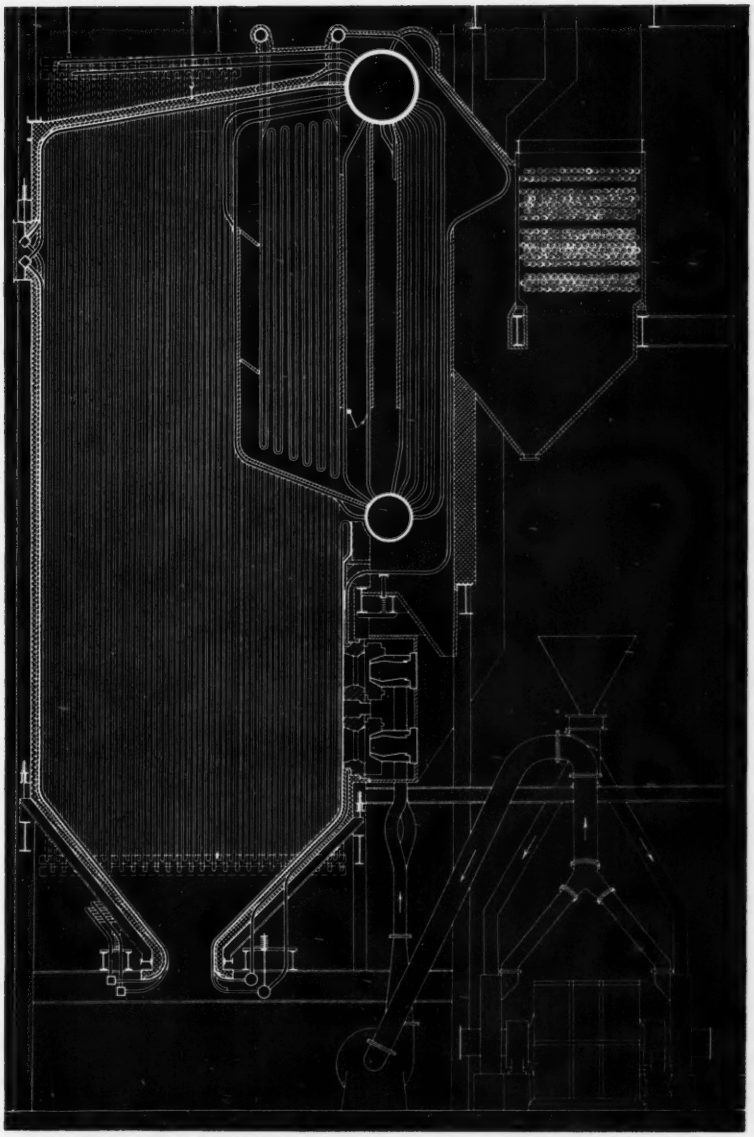
A NEW LINE of small steel valves announced by Crane Co., Chicago, Ill., includes gates, globes, angles, and checks, in sizes ¼ to 2 in. inclusive, and embodies both inside screw and O.S. & Y. construction, union and bolted bonnets, screwed, socket weld, and flanged ends.

Gate valves made of cast steel with O.S. & Y. construciton having union bonnet type in screwed ends in sizes ¼ to ¾ in. inclusive, and bolted bonnet with screwed, socket weld, and flanged ends in sizes ½ to 2 in. inclusive (½ and ¾ in. are available in both union and bolted bonnet).



Globe and Angle valves made of forged steel in two types: inside screw and O.S. & Y. construction. Inside screw valves have screwed ends with union bonnet in sizes ¼ to ¾ in. inclusive, and bolted bonnet in sizes 1 to 2 in. inclusive. O.S. & Y. valves have screwed ends with union bonnet in size ¼ to ¾ in. inclusive, and screwed socket weld, and flanged ends with bolted bonnet in sizes ½ to 2 in. inclusive (½ and ¾ in. are available in both union and bolted bonnet).

Check valves also made in two types; the horizontal pattern is forged steel with union cap and screwed ends in sizes ¼ to ¾ in. inclusive, and with bolted cap and screwed, socket weld, and flanged ends in sizes ½ to 2 in. inclusive (½ and ¾ in. are available in both union and bolted cap). The vertical ball pattern is cast steel with bolted joint and screwed ends in sizes ½ to 2 in. inclusive.



ATLANTIC CITY

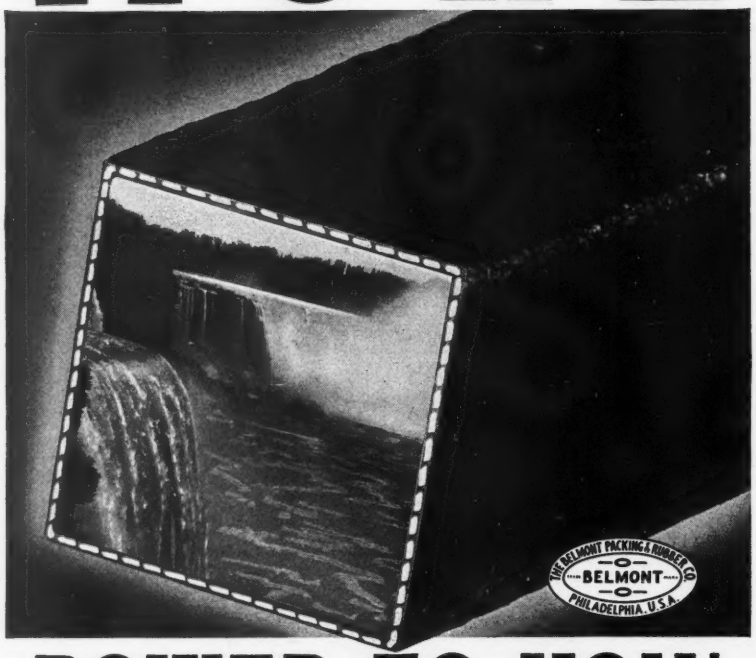
300,000 pounds of steam per hour
955 deg. F. final steam temperature
1,385 lb. pressure per square inch

Atlantic City Electric Company selected this design after a complete investigation of the performance of a similar high pressure steam generator in severe service.

FOSTER WHEELER CORPORATION - 165 BROADWAY - NEW YORK, N. Y.

FOSTER WHEELER

MORE



POWER TO YOU!

PACK WITH BELMONT

No matter how small—power leaks are costly. That's why Belmont takes such minute care in the construction of Belmont Hydraulic Packings.

Take Belmont 319, for example. Only the finest quality rubber friction duck is used. The hollow center, which was originated by Belmont, provides a point of least resistance for contraction and expansion. This also serves to keep friction at a minimum, since the packing tends to "breathe" towards the "hole," as varying pressures are exerted upon it in the stuffing box.

This type of construction care is not an isolated example. It's the rule for the entire Belmont Line. See for yourself. A request on your company letterhead will bring the new 1940 edition of the Belmont Catalog to you absolutely free.

SUGGESTED PACKINGS FOR WATER SERVICE

BELMONT 319

Hollow Center Packing

Made of finest quality closely woven rubber frictioned duck, wrapped on itself and moulded to size. Supplied in packing space sizes ¼" and over; lubricated and graphited unless otherwise specified.

BELMONT 9

Special Hydraulic Packing

Made of Long Line best quality Flax stitched with strong linen thread into a moulded rubber and duck channel. The double combination of casing and flax makes two packings in one against the wearing surface. Supplied lubricated and graphited unless otherwise ordered, in all packing space sizes from ¼" upward.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

BELMONT

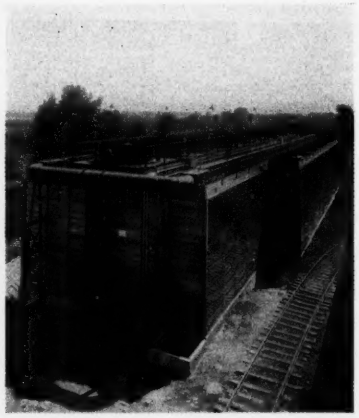
PACKINGS

THE BELMONT PACKING & RUBBER COMPANY

BUTLER AND SEPVIVA STREETS • PHILADELPHIA, PA.

Cooling Tower

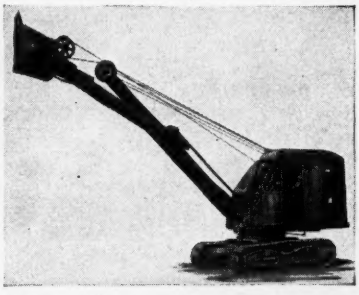
AFTER two years of testing and proving, The Marley Co., Kansas City, Kan., announces a new type of cooling tower which is known as the Double-Flow Tower, and is especially developed for heavy-duty large-capacity service. The design is an advancement from the induced draft type. Mixture of water



with moving air is uniformly complete throughout the interior area. Air flow is without turbulence since it is horizontal from both sides to the center chamber. The water distribution system is entirely external, simplifying inspection and maintenance. This tower is all-bolted, diagonally-braced and of extra rugged construction. Reduction in pumping costs is due to the low height and a distribution system which requires no pressure. The tower is also free from icing-up in winter.

Shovel

A NEW, powerful, full-size ½-yard convertible shovel-dragline-crane, Model LS-60, is announced by Link-Belt Speeder Corp., 301 W. Pershing Road, Chicago, Ill. Several advancements included in this new model are, self-aligning roller bearings on drum shafts, reverse shaft and main power shaft; a new safety-type rapid boom-hoist for crane duty, with conventional worm-geared boom-hoist



optional; fully enclosed traction gears running in oil; double fully-enclosed traction brakes controlled from the cab; a 56 in. machine-finished roller path turntable with roller bearing "hook" rollers; interchangeable clutches on drum, swing, retract and boom hoist; welded steel design for strength and resistance to shock load and to provide positive alignment of machinery parts; glass all around in operator's cab. The engine is 60 hp., gasoline or Diesel. Track shoes are 16 in. of the lug-driven type.

POWELL IRON BODY VALVES

Records show Powell Iron Body Valves endure far beyond specifications. Their rugged construction and workmanship have long been recognized by plant engineers who demand unusual valve performance.

FIG. 1410
SCREWED END "MASTER PILOT"
GATE VALVE

FIG. 1444
FLANGED END "MODEL STAR"
GATE VALVE

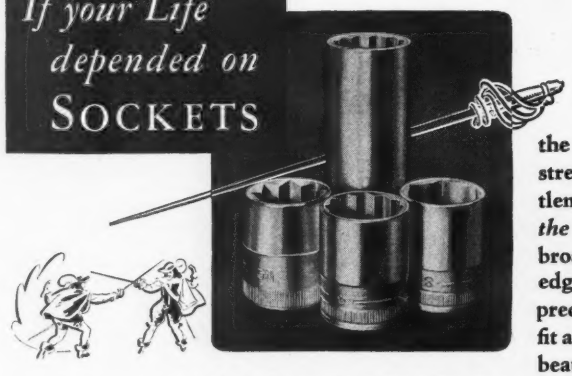
FIG. 241
FLANGED END "MODEL STAR"
GLOBE VALVE

For complete information on Powell Iron Body Valves refer to the Powell new No. 11 Catalog.

POWELL VALVES

THE WM. POWELL CO. CINCINNATI, OHIO

If your Life depended on SOCKETS



. . . you'd check on the *steel* in those sockets, on the way they were broached, shaped, hardened. Lives *do* depend on sockets . . . on the way nuts are turned, tightened and adjusted. So for *safety's* sake, for finer workmanship and greater speed in production and maintenance . . . promote the use of *good* sockets in your plant. Snap-on sockets are famed for fine steel . . . electric furnace toughened for the greatest tensile strength without brittleness, hardened *all the way through, hot*-broached for clean-edged, non-slip grip, precision machined for fit and finish. Like the beautiful blades of Toledo that shaped history in days of old, Snap-on sockets have shaped modern tool methods . . . for Snap-on *originated* sockets, today makes the world's largest selection of styles and sizes. Full information about 2300 Snap-on Tools gladly sent on request.

Snap-on Wrenches
The Best Tools are the Safest Tools

Snap-on Tools Corporation
Dept. PPE-5 Kenosha, Wisconsin

Totalize Steam Flow Accurately

WITH THE

SIMPLEX GYROMETER

Accurate knowledge of all flows, irrespective of the service involved, is necessary if economical overall plant operation is to be obtained.

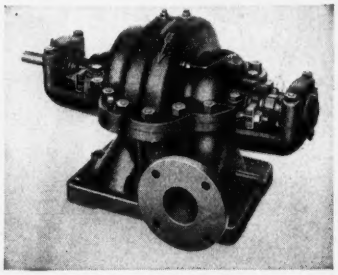
The Gyrometer, because of its low first cost and minimum maintenance requirements, NOW offers a means of metering services that have previously been neglected.

Let us show you how the Gyrometer can help you to make operating savings.

SIMPLEX VALVE & METER CO.
6790 Upland St., Philadelphia, Pa.

Two-Stage Pump

FAIRBANKS, MORSE & Co., 600 S. Michigan Ave., Chicago, Ill., has developed a line of two-stage, split-case pumps with capacities up to 550 g.p.m. at heads ranging up to 600 ft. T.D.H. These units are suited to all classes of general pumping service where the liquid is of low viscosity and free from foreign matter. One-piece impellers are made of cast iron, hard bronze, or other



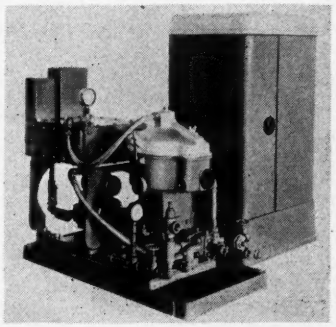
alloy depending on requirements. They are mounted "back to back" on the shaft to assure proper hydraulic balance. Removable wearing rings with streamlined water guiding surfaces are provided on both casing and impeller. The shaft, made of high manganese alloy steel, is journaled in ball bearings of ample size to withstand all thrust and radial loads.

Thinsulite

BY COMBINING thin refractories, insulation, and the suspended tile principle, a complete suspended enclosure is now available from M. H. Detrick Co., 140 South Dearborn St., Chicago, Ill. Thinsulite, as the new product is known, is suitable for boiler walls, water wall backing, oil still heaters and stress relieving furnaces—in fact, all areas not exposed to actual abrasion.

Oil Purifier

TO KEEP the lubrication system of engines continuously clean, Goulds Pumps, Inc., Seneca Falls, N. Y., announces its Combined Centrifugal Clay Filter Oil Purifier with a centrifuge to keep the oil mechanically clean and a filter with Fullers earth to remove gums and other soluble contaminates and restores the color.



The centrifuge removes all moisture and all but a slight percentage of other impurities before the oil is passed through the filter, therefore leaving very little work for the filter to do and increasing the periods between filter refills. Positive protection against possible migration of clay to the engine system is made possible by passing the filtered oil back through the centrifuge.

WE GOT the jump on Uncle Sam by starting our own census — a census of Veteran Jenkins Iron Valves — to provide material for a comprehensive test of the COST-PER-YEAR method of computing valve costs.

Here is a report from the Piedmont Cotton Mill, Egan, Georgia. A 4" Jenkins Iron Body Globe Valve installed on steam feed from boiler to pump has been opened and closed an average of 3 times per day since it was installed in 1899.

Engineer Paul F. Waller, in the employ of the mill since 1900, confirmed the information that the valve had been under constant pressure every day—even during shut downs—to maintain pressure in case of fire.

The only parts replaced were gaskets. Composition disc was re-faced with a lathe once and reversed once. Total maintenance cost about $.49... Now check the cost-per year figures in the box and you'll see why "Jenkins Iron is your best buy".

JENKINS BROS., 80 White St., New York, N.Y.; Bridgeport, Conn.; Boston; Atlanta, Ga.; Philadelphia, Pa.; Chicago, Ill.; Houston, Texas Montreal, Canada London, England

"COST-PER-YEAR" of this Jenkins Iron Valve

(Fig. 142)

Initial Cost *(installed 1899)* . $17.55

\+

Total maintenance *(new gaskets)* .49

÷

Years of Service 41

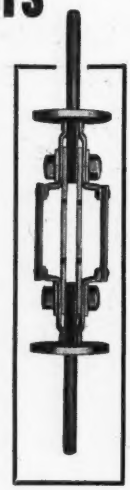
=

Cost-per-year 44

and it's still going strong!

IN VALVES *Jenkins* GIVES YOU EVERYTHING

100% PROTECTION FOR YOUR CIRCUITS



Decide now to do away with the bother and expense of old-style fuses — specify WARE HI-LAG Fuses on all your plant circuits for maximum protection at minimum cost.

These improved WARE HI-LAG Fuses provide an extremely **high time lag** which ends the blow-outs often caused by starting motors and momentary surges.

Then, too, their new **double-bridge** assembly is easier to renew correctly than to overload. Only one end of casing is removed. Assembly may be inserted either end first. Other advantages include Spring Tension Contacts, One Piece Flat Link.

WARE BROTHERS, 4500 Lake St., CHICAGO

Write for Booklet *and*
TRIAL TEST OFFER

Machinery Exports Up in January

ACCORDING to the Machinery Division of the Department of Commerce, United States exports of industrial machinery advanced sharply in January, reaching the record monthly total of $28,908,808, a 60 per cent gain over January, 1939. Increases ranging from 11 to 118 per cent were recorded in six of the seven major machinery groups.

January exports of power-generating machinery, excluding electric and automotive, totaled $1,494,777, approximately double the trade in the corresponding month of 1939 which amounted to $746,076. Practically all items in this group shared in the increase. Shipments of Diesel and semi-Diesel engines were more than double those a year ago, amounting to $188,862 as compared with $77,881. Corresponding gains were registered in other types of internal combustion engines, the exports of which advanced to $238,524 compared with $109,745, while in engine accessories and parts the trade advanced to $283,162 against $186,666. Larger shipments were also made of water tube steam boilers which were valued at $71,858 during the month compared with $51,877 for January, 1939. Shipments of steam specialties were valued at $105,765 in January against $92,062 in January, 1939.

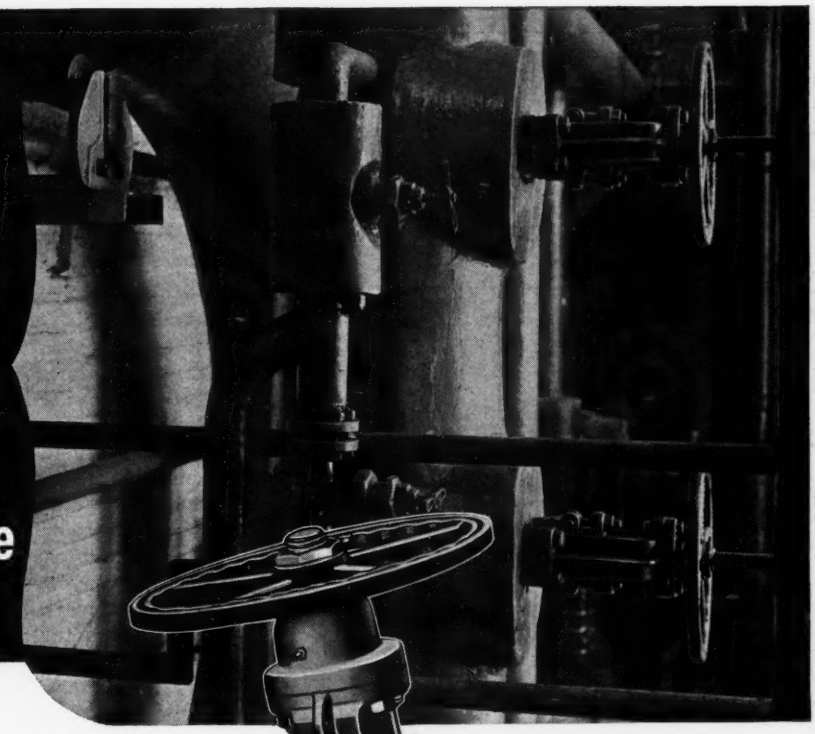
Valued at $1,637,647, the exports of construction and conveying machinery in January were 11 per cent greater than the trade in the same month of last year which amounted to $1,479,316. In this group, exports increased in dredging machinery, $96,879 against $95,119 a year ago; road rollers, $63,697—$32,233; other road making machinery, $381,019—$380,586; cranes, $88,983—$27,587; hoists, $101,731—$48,891; elevators, $107,311—$54,194; and conveyors, $19,515—$9,859. Exports of excavators, parts and accessories were down slightly to $400,330 from $441,382.

Setting Heights for Underfeed Stokers

FOR SEVERAL years the Engineering Committee of the Stoker Manufacturers Association has been studying the problems of stoker and boiler setting heights and combustion space for underfeed stoker-fired boilers burning bituminous coal in capacities ranging from the smallest household unit up to machines burning 1200 lb. of coal per hour. After a series of conferences and a special field survey and test project, undertaken and completed in 1939, the Engineering Committee recommended that standard practices governing minimum setting heights be adopted by the national stoker organization in accordance with recommendations and studies made by this committee. Final action was taken by the Stoker Manufacturers Association at a meeting of its executive representatives in Chicago on March 12 and approval of the Engineering Committee's rec-

Continued on Page 110

COLUMBIA MISSOURI *Saves* $25,000 yearly in fuel cost alone

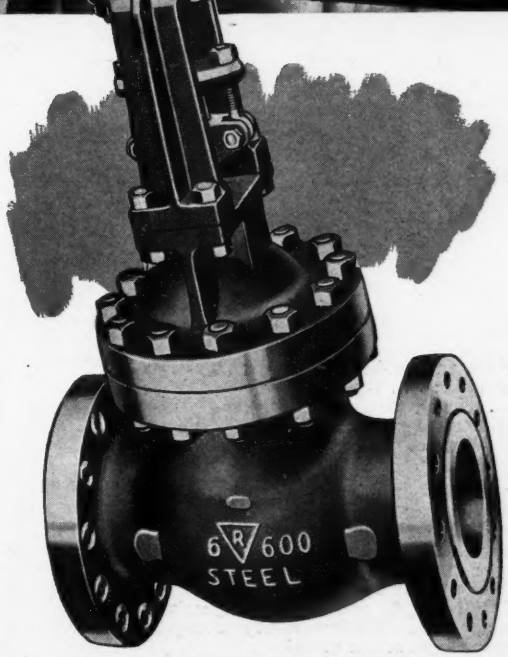


Reading-Pratt & Cady Fig. 4001 Cast Carbon Steel Gate Valves on the 400 lb., 750° F. steam header in the modernized power plant of the Water and Light Department, Columbia, Mo. Capacity, 60,000 lbs. of steam per hour.

★ Groeschel Company, Contractors, of Marshall, Mo., and D. Elrow Crane, Superintendent of the plant for the City of Columbia report that operations to date justify *expected savings of over $25,000.00 yearly in fuel costs alone.*

Naturally, Reading-Pratt & Cady are gratified that engineering responsible for such savings should approve and install Reading-Pratt & Cady Valves so completely.

You, too, will find it good business to get Reading-Pratt & Cady recommendations for valves in your plant.



Reading-Pratt & Cady Fig. 6001, Cast Carbon Molybdenum Steel Gate Valves used on the 600 lb. 225° F. feed water lines.

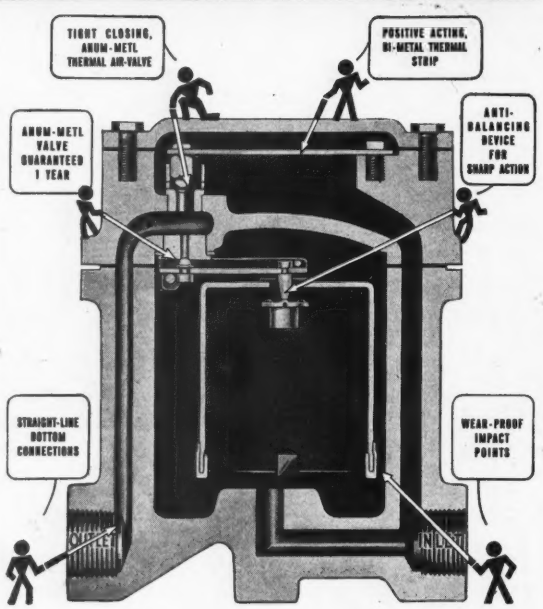
READING-PRATT & CADY

READING-PRATT & CADY DIVISION · BRIDGEPORT · CONNECTICUT

AMERICAN CHAIN & CABLE COMPANY, Inc.

PIPEWRENCH PETE SAYS:

HERE'S THE SURE WAY TO GET HEAT FAST AND CHEAP

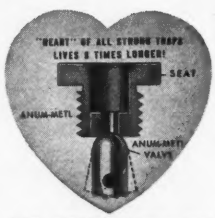

TIGHT CLOSING, ANUM-METL THERMAL AIR-VALVE
POSITIVE ACTING, BI-METAL THERMAL STRIP
ANUM-METL VALVE GUARANTEED 1 YEAR
ANTI-BALANCING DEVICE FOR SNAP ACTION
STRAIGHT-LINE BOTTOM CONNECTIONS
WEAR-PROOF IMPACT POINTS

STRONG 70-T TRAP

EVERY FEATURE A MONEYSAVER!

Unit heaters and cookers can be lazy or quick . . . tepid or torrid . . . costly or cheap. They're efficient only when you remove air and water quickly, so steam can fill them.

That makes the trap important. Makes the 6 moneysaving features of STRONG'S 70-T quick-starting trap vital if you're going to get heat FAST and CHEAP! Same sturdy construction as STRONG'S 80 series trap. A year's guarantee against leakage, too. Worth a 90-day money-back test? Your inquiry will get action quick!



ALL STRONG traps and valves have seats and discs of special ANUM-METL that lasts 8 times longer than even STRONG'S former parts. A big moneysaver!

HOW DO YOU SIZE TRAPS? Easy, practical method in Catalog 63-PE5. Send for yours today.

The Strong, Carlisle & Hammond Co.
1392 West Third St., Cleveland, O.

5

STRONG
STEAM SPECIALTIES

ommendations as to minimum setting heights was unanimously given. These minimum setting heights in the form of two simple curves are incorporated in the S. M. A. Standard Code.

The formulas from which the curves were calculated are:

For burning rates up to 100 lb. coal per hr.

$$H = 0.1125B + 15.75$$

For burning rates from 100 to 1200 lb. per hr.

$$H = 24 + 0.03B$$

In which H = minimum setting height in inches and B = burning rate in pounds of coal per hr.

This standard does not attempt to prescribe hard and fast rules governing the installation of underfeed stoker equipment in various types and sizes of boilers burning bituminous coal. It does, however, offer to the industry and to the allied trades the recommendations of the underfood stoker industry itself as to the allowable minimum clear space between the stoker retort and the crown sheet of the boiler. These standards are based on the practical experience of the leading manufacturers, as well as dealers and installers, in the stoker industry over a period of many years covering hundreds of thousands of installations plus research work which has been conducted by the Association in cooperation with national organizations in the coal industry, the boiler industry, and in cooperation with the Smoke Prevention Association.

Proposed Expenditures by Utilities

IT HAS been reported by the Federal Power Commission that the proposed construction expenditures by electric utilities during 1940 total $593,879,533. Of this amount $227,060,565 will be spent for generating plants and $366,818,968 will be spent for other electric plants. Of the total, $490,434,261 will be spent by privately owned utilities and $103,445,272 by publicly owned utilities.

Additional installed capacity amounting to 1,877,844 kw. during 1940, of which 1,332,635 kw. are to be added by privately owned utilities and 545,209 kw. are to be installed by publicly owned utilities. The scheduled additions of hydroelectric installations by privately owned utilities total 57,000 kw. and by publicly owned utilities 234,175 kw. Scheduled additions of 1,264,085 kw. are to be added in privately owned steam plants and 270,372 kw. in publicly owned steam plants; 11,550 kw. of internal combustion generating equipment will be added by privately owned utilities and 40,662 kw. by publicly owned utilities. On January 1, 1940, the total installed capacity of all generating equipment was 40,317,924 kw.; of hydroelectric plants, 11,415,165 kw.; of steam plants, 28,046,948 kw. and of internal combustion engine plants, 355,811 kw.

Continued on Page 112

The eight De Laval turbine-worm gear units

HELP *in a* TIGHT SQUEEZE

Four of the eight 185 hp. turbines driving fans through 6 5/6 to 1 ratio worm gears

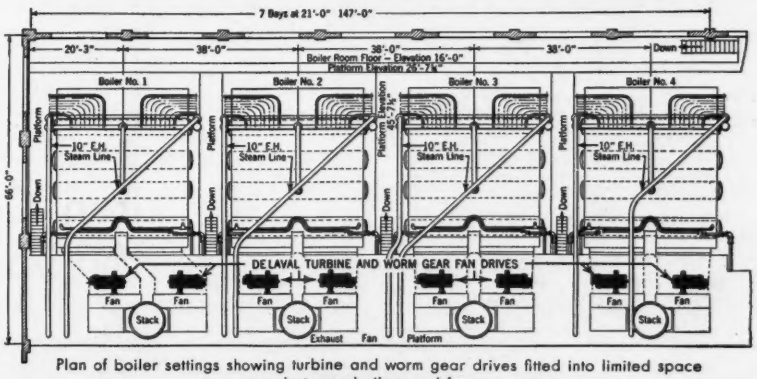
REQUIRING more steam, but lacking space for more boilers, the engineers of a blast furnace plant decided to increase the fuel-burning and steaming capacity of the existing boilers by raising them to gain furnace volume and by installing induced draft fans. Then it was found that there was scarcely space for the fans and for turbines with speed reducers to drive them.

The problem was solved by selecting

DE LAVAL
VELOCITY STAGE TURBINES
driving through
DE LAVAL WORM GEARS

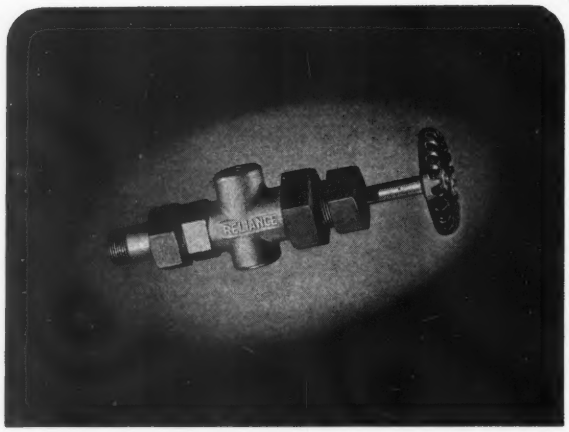
The right-angled drive permitted placing the turbines alongside the fans, while the hydraulic governors of the turbines are well suited for automatic speed control to give a draft range of 4 to 1. Each unit has forced feed lubrication from a De Laval-IMO oil pump, which also supplies oil for governing.

Write for leaflet 1-3515 "Modern Turbines to Reduce Costs".



Plan of boiler settings showing turbine and worm gear drives fitted into limited space between boilers and fans

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.
MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL; and FLEXIBLE COUPLINGS



RELIANCE STEEL VALVES for High Pressure Gages

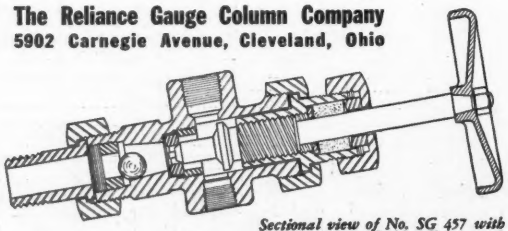
save upkeep bother and replacement expense

Have the assurance of sturdy forged steel leak-proof Reliance Gage Valves on your high pressure boilers. Here's Reliance No. SG 456 for situations where you want long-lived valves with pipe tap for gage insert nipples.

You avoid frequent replacement with these Reliance valves. Long-wearing seats—easily reversible, renewable and regrindable for low-cost maintenance; triple-thread quick closing stem of stainless steel; seat and disc lapped to glass-hard surface by special Reliance process.

Available with or without automatic ball check shutoff. Also in stainless steel for acid service. Lever-chain operation at no extra cost. Write today for new Reliance Gage Valve Bulletin 401.

The Reliance Gauge Column Company
5902 Carnegie Avenue, Cleveland, Ohio



Sectional view of No. SG 457 with ball check cut-off. Metallastic stem packing; union tank connection.

Reliance
Boiler Safety Devices since 1884

Budgeted expenditures during the current year for hydroelectric plants total $3,337,110 by privately owned utilities and $46,731,000 by publicly owned utilities. Budgeted expenditures for steam plants total $150,781,568 by privately owned utilities and $21,273,242 by publicly owned utilities. Similarly, budgeted expenditures for internal combustion generating equipment total $1,098,967 by privately owned utilities and $3,838,678 by publicly owned utilities.

Fluid Flow Study

ECONOMIC possbilities of smaller pipe sizes especially for radiator connections in forced hot water heating systems demand urgent research investigation, in the opinion of A. E. Stacey, Jr., New York, N. Y., chairman of the American Society of Heating and Ventilating Engineers Committee on Research. With plans for huge housing developments requiring more accurate engineering data on the frictional resistance of large pipe sizes a Research Technical Advisory Committee on Flow of Fluids through Pipes and Fittings has been appointed with S. R. Lewis, consulting engineer, Chicago, Ill., and past president of the Society, as chairman. Although the immediate plans of research activity are to study hot water flow it is anticipated that this committee will also consider in the future such fluid flow problems that deal with air and steam.

Arrangements have been made to conduct the first experimental investigations under a cooperative agreement with the Society at the Texas Agricultural and Mechanical College where Dr. F. E. Giesecke, College Station, Texas, now president of the Society, will personally supervise the research program.

Other members of the committee who are responsible for outlining and supervising this work are: L. A. Cherry, Buffalo, N. Y.; G. C. Davis, Winnipeg, Canada; T. M. Dugan, McKeesport, Pa.; Earle W. Gray, Oklahoma City, Okla.; R. T. Kern, Fitchburg, Mass.; H. A. Lockhart, Chicago, Ill.; Axel Marin, Ann Arbor, Mich.; R. F. Taylor, Houston, Tex., and E. L. Weber, Seattle, Wash.

Iron Company Contracts for Bonneville Power

THE SIERRA Iron Co., a recently organized Nevada corporation, has signed a 20-yr. contract with the Bonneville Power Administration for purchase of large blocks of Bonneville power with which to operate an iron ore reduction plant to be built on the outskirts of Vancouver, Washington. The contract provides for the delivery of successive blocks of Bonneville power up to 6000 kw. during the next year and contemplates additional deliveries up to a total of 30,000 kw. within 2 yr.

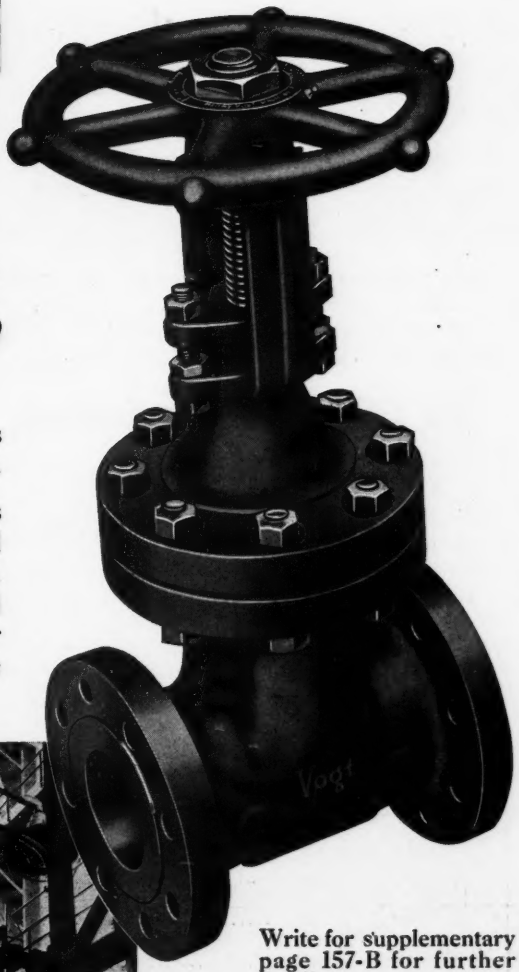
Continued on Page 114

and NOW!

THE 300 POUND LINE

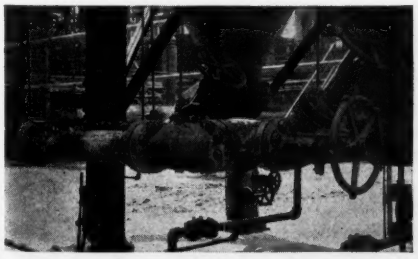
INTEGRAL FLANGED

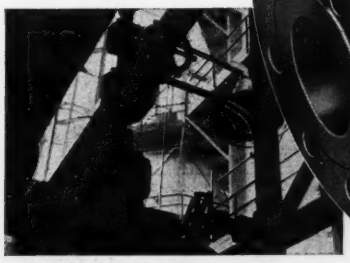
Drop Forged Steel GATE VALVES by Vogt



Never before has a new line of valves CLICKED so rapidly as our 150 Pound Series.

Now follows the 300 Pound line in sizes from 2" to 8", with flanges forged integral, and complying with the 300 Pound American Standard. Stainless Steel Trimmings are regularly furnished and we recommend them for steam, water, oil or gas service up to 300 pounds working pressure and temperatures to 750 deg. F.



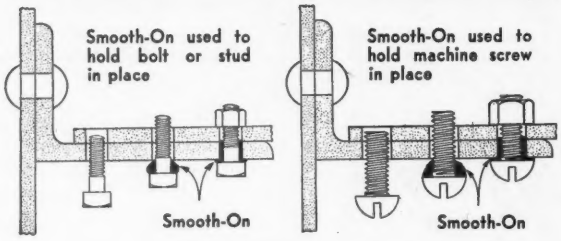


Write for supplementary page 157-B for further details.

HENRY VOGT MACHINE CO., INC., LOUISVILLE, KENTUCKY

BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

To make screws or bolts hold in unthreaded holes



—One of the dozens of uses for Smooth-On No. 1

Screws and bolts that drop out of place or are difficult to hold when parts are being assembled, can be held with Smooth-On No. 1. The use of Smooth-On No. 1 avoids the necessity and expense of threaded holes, and holds the bolt or screw to permit the application of the nut. Screws and bolts in oversize holes can be centered and held, making assembly of parts easier.

Many other troublesome jobs made easy

This is but one of many ways by which Smooth-On saves time, labor and money in attaching metal parts, sealing cracks, repairing breaks, stopping leaks, making joints tight, etc., on apparatus and pipe lines.

The FREE Smooth-On Handbook explains how

This 40-page handy manual describes many applications of Smooth-On around the plant, and contains dozens of suggestions that will help you reduce your plant maintenance and repair expenses. More than 160 diagrams show how Smooth-On has enabled other engineers to handle routine and emergency jobs ingeniously and at surprisingly low cost. Your copy free if you send the coupon.

Buy Smooth-On in 1-lb., 5-lb. cans or 25-lb., 100-lb. kegs from your supply house or if necessary, from us. For your protection, insist on Smooth-On—used by engineers since 1895.

SMOOTH-ON MFG. CO., Dept. 31,
570 Communipaw Ave., Jersey City, N. J.
Please send SMOOTH-ON HANDBOOK.

Name .....

Address .....

5-40 .....

Do it with **SMOOTH-ON**

The Sierra Iron Co. expects to develop the Vancouver plant to a capacity of 100 t. of pig iron per day before the end of the year and plans ultimately, on the basis of 30,000 kw., to produce approximately 500 t. daily. Construction will begin immediately, with plant completion scheduled within two months.

The process to be used by the Sierra Company involves electric smelting of ore to be obtained from iron deposits in the vicinity of Scappoose, Ore. Some magnetite ore may be shipped from other points to the plant when needed. Coal necessary to the operation will be obtained from the Chehalis, Wash., area, and limestone from several points in the Pacific Northwest. Much of the plant's immediate production will be consumed in the local manufacture and on the Pacific Coast.

The Sierra Company plant will be located near the municipal terminal No. 2 at the edge of the city of Vancouver. The site is owned by the city.

Public Service Reports Progress

STOCKHOLDERS of Public Service Corporation of New Jersey at its annual meeting April 15 in Newark were given an optimistic picture of the corporations business by Thomas N. McCarter, chairman of the board. It was reported that business of the corporation in 1939 was good, the gross increased and operation was relatively economical. Earnings on the common stock, after payment of preferred stock dividends and all other charges, was $2.88 a share of which $2.50 was paid in common dividends. "If earnings are to decrease in 1940, it hasn't shown yet", Mr. McCarter said in reporting that earnings for the first three months this year were extremely good. The chairman pointed out that prices for coal and oil had increased, for which the companies had made budgetary allowances after expiration of contracts which ran to April 1.

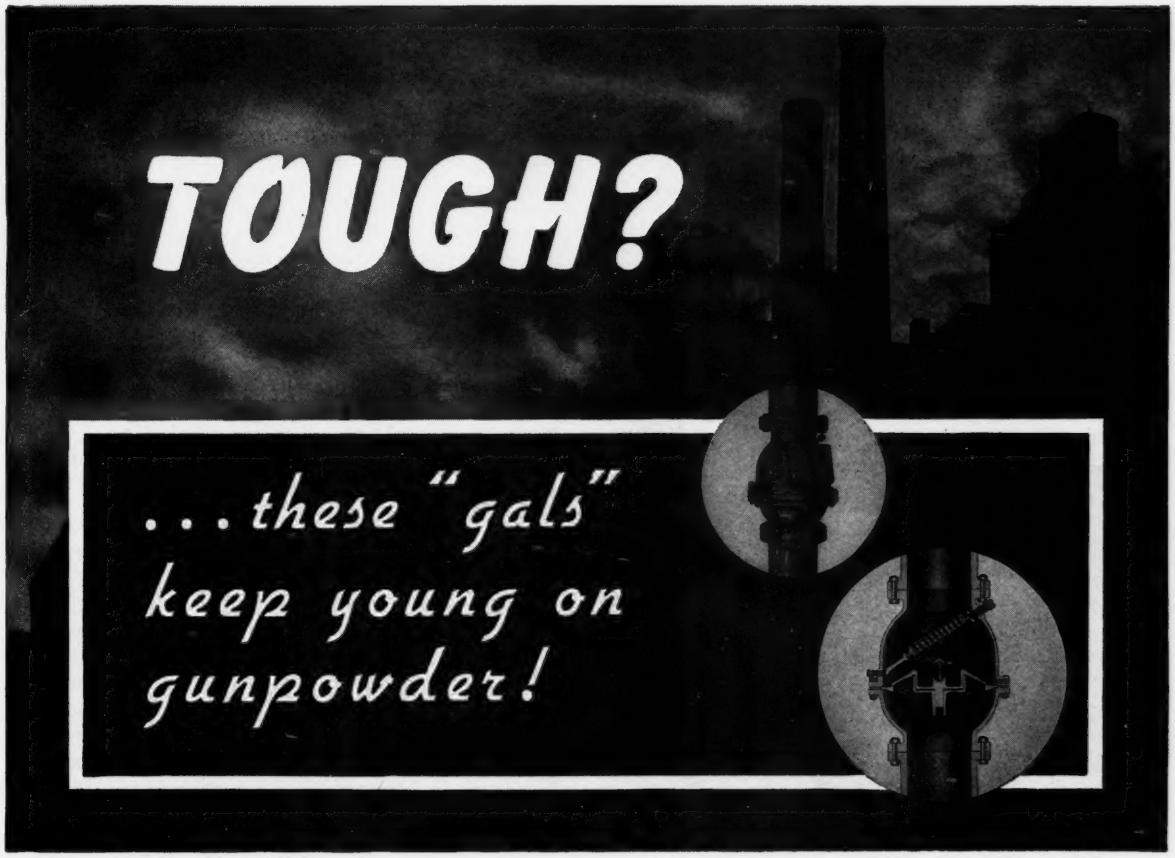
Mr. McCarter discussed at some length the proposed reorganization of the corporate structure which, he said, has made substantial progress. Most, if not all, of the mergers of underlying companies into Public Service Electric and Gas Company had been completed by this time last year, and during the past year reorganization of Public Service Coordinated Transport has progressed.

"This has been and is a herculean task", he said. "You realize a very great electric railway system has practically passed into oblivion and has been substituted by the largest bus system in the country—in fact, the largest in the world except the London Omnibus".

Percy S. Young, William H. Speer, Ogden H. Hammond and Theodore Boettger were re-elected directors of the corporation for three years.

At meetings of Public Service underlying companies the following directors were re-elected: Thomas N

Continued on Page 116



In February of 1903, an explosive manufacturer ordered two Foster Back Pressure Valves for his plant in northern New Jersey.

Thirty-six years later—in June of 1939, to be exact—the chief engineer of the successor company in Delaware writes . . .

> "We have in our possession two of your back pressure valves; one 5 inch No. 36738, and the second an 8 inch No. 39488.
>
> We are considering using these valves at another works, and would appreciate receiving your report as to the operating conditions under which the valves were purchased.
>
> A drawing showing the working parts of the valves would also be appreciated and a repair list, so that parts can be ordered if required."

These "ladies" may be smooth performers, but there's nothing delicate about their constitution. Thirty-six years of hard work haven't changed their form or figure!

If you are interested in accurate and dependable regulation or control with the lowest cost for maintenance throughout years of service, investigate Foster—first.

DUPLEX BACK PRESSURE and VACUUM BREAKER

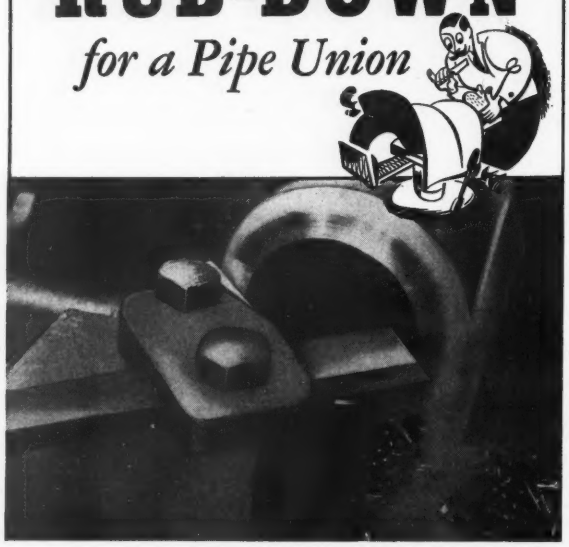
- Designed to maintain a constant back pressure on non-condensing systems when exhaust steam is utilized, this Foster Duplex Back Pressure and Vacuum Breaker can be installed as a vacuum breaker or a free relief valve.
- The rugged construction of this valve permits continuous operation on severe service without loss of efficiency. Self-contained, it has no outside dash-pots, levers, or weights.
- A simple compensating spring maintains a constant relation between spring and back pressure regardless of valve position or stage of spring compression . . . chattering is eliminated. The valve can be opened manually.

FOSTER ENGINEERING Company

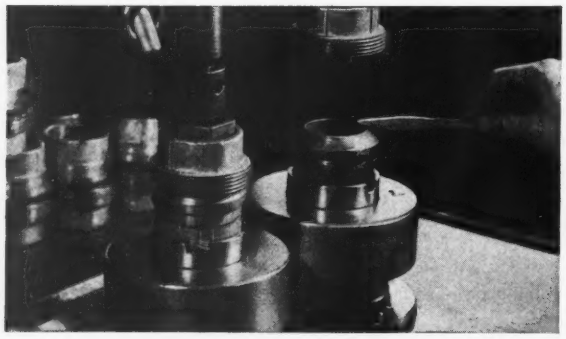
PRESSURE REGULATORS • RELIEF AND BACK PRESSURE VALVES • AUTOMATIC STOP AND CHECK VALVES • ALTITUDE VALVES • DAMPER REGULATORS • FAN ENGINE REGULATORS PUMP GOVERNORS • TEMPERATURE REGULATORS • LIQUID LEVEL CONTROLLERS • FLOAT AND LEVER BALANCED VALVES • NON-RETURN AND TRIPLE DUTY VALVES • VACUUM REGULATORS OR BREAKERS • SIGHT FLOW BOXES • STRAINERS • SAFETY VALVES

111 MONROE STREET • NEWARK, N. J.

SHAVE
and a
RUB-DOWN
for a Pipe Union



Here are two extra features in Darts, that you won't find in ordinary unions: Dart's two bronze seats first get *a clean shave* by precision machining to a true arc, then a *rub-down* by a special grinding process on machines of Dart's own design.



These two exclusive processes assure you *more service per dollar* by providing tightness under repeated use. Darts make up tight, come apart readily, can be used over and over. That's real economy. Send for a Dart to try, free.

DART
UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.
Sales Agents: The Fairbanks Company, New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

McCarter, Edmund W. Wakelee, Percy S. Young, George Barker, George H. Blake, Matthew R. Boylan, John A. Clark, John L. O'Toole, Edward C. Rose, Jacob T. Barron, Henry P. J. Steinmetz.

Stockholders of the three system gas companies—Atlantic City Gas Company, Peoples Gas Company and County Gas Company—re-elected all the present directors, with the exception of John L. Conover, who was replaced by Franklin Heydecke. Mr. Heydecke is general auditor of the Corporation and Public Service Electric and Gas Company. Mr. Conover, who was general auditor, gas department, has become general commercial manager.

Engineering Foundation Reports on Research

SEVENTY-THREE research projects involving an aggregate of $3,111,374 have been carried out by The Engineering Foundation since it was established in 1914 by Ambrose Swasey, Cleveland manufacturer, "for the furtherance of research in science and engineering or for the advancement in any other manner of the profession of engineering and the good of mankind."

Notable contributions have been made to science, engineering, industry, and the humanities during a 25-yr. period characterized by profound change, says a report made public by Dr. Otis E. Hovey, director of the Foundation. The opportunities for productive research are constantly increasing in number and scope, it is declared.

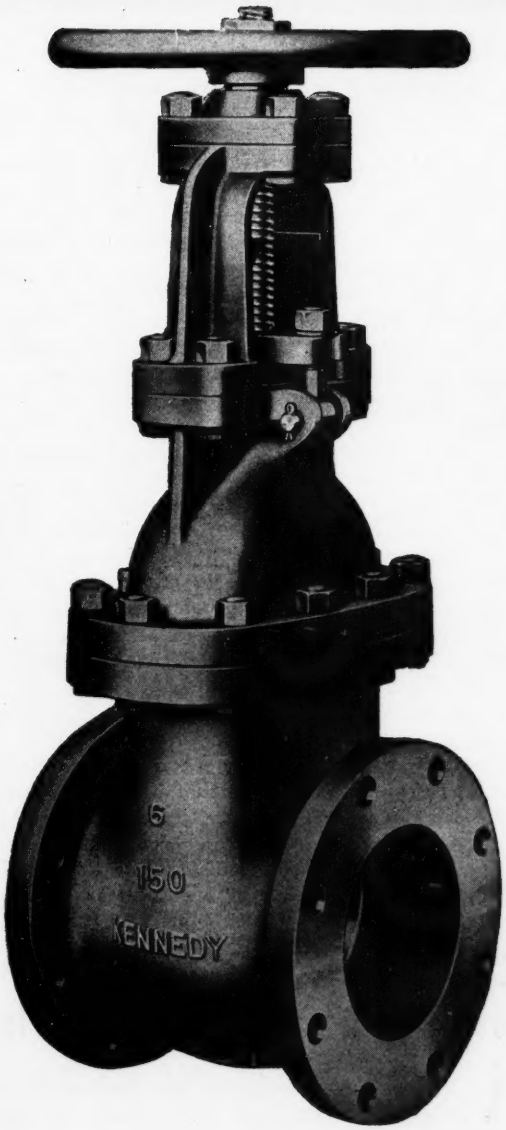
"Researches have been assisted by funds appropriated from the income of the investments of the Foundation to an amount of over $400,000," says the report. "Cash contributions for certain projects have passed through the accounts of the Foundation to an amount of nearly $500,000.

"In addition, other large sums have been contributed by the four founder societies of civil, mining and metallurgical, mechanical, and electrical engineers, and by individuals, corporations, and industry. Likewise, the use of facilities made available by educational institutions and laboratories, and the expert supervision freely donated by many individuals have been of great value, but a large part of such service cannot be expressed in an equivalent money value."

A ten-year research in the field of alloys of iron representing, in cash contributions and service, an outlay of $426,677 was among the chief activities. With the cooperation of eighty-eight manufacturers, research institutes, technical societies, and federal bureaus, hitherto inaccessible world knowledge of steel and iron, and their alloys has been assembled from scientific and technical literature of many nations. The results have been embodied in eleven monographs by a committee of which Professor George B. Waterhouse of Massachusetts Institute of Technology, representing the American Institute of Mining and Metallurgical Engineers, is chairman and director.

Continued on Page 118

STURDY IN EVERY PART



HERE is a standard iron body wedge gate valve design that has every security, convenience and refinement you would recommend from your own experience in using valves.

The bodies will not distort, because of their strong oval shape well-filleted at all corners, and heavy section reinforced at neck and flanges. The discs will not spring, because of their heavy supporting posts and long body guides. The stem will not become scored, because the yokes, glands, stuffing boxes and body caps are all bronze-bushed where the stem passes through.

The design has special provisions for ease of connecting up, operating, and repacking, and many of the refinements that promote dependable service and long life are not obtainable in any other design.

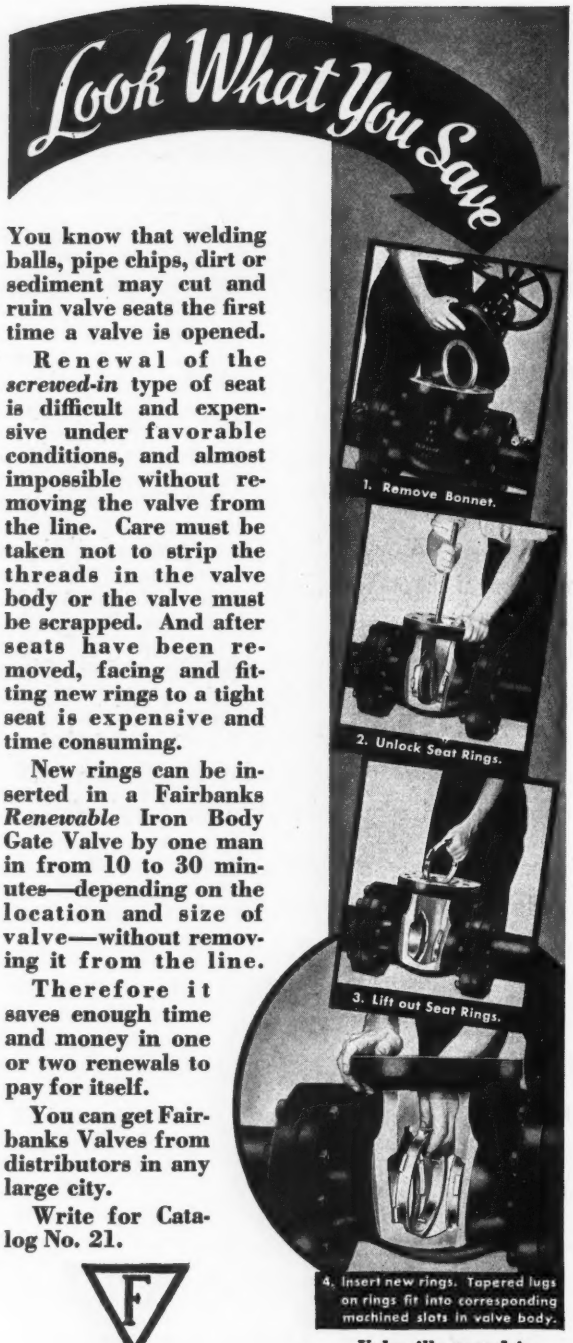
These valves like all Kennedy products set a high standard of quality and service — at standard market prices. You are safe when you standardize on Kennedy.

Write for bulletin
describing these valves in detail

The Kennedy Valve Mfg. Co.
Elmira, N. Y.

Offices and Representatives in principal cities

KENNEDY
VALVES with Extra Value


Look What You Save
1. Remove Bonnet.
2. Unlock Seat Rings.
3. Lift out Seat Rings.
4. Insert new rings. Tapered lugs on rings fit into corresponding machined slots in valve body.

You know that welding balls, pipe chips, dirt or sediment may cut and ruin valve seats the first time a valve is opened.

Renewal of the *screwed-in* type of seat is difficult and expensive under favorable conditions, and almost impossible without removing the valve from the line. Care must be taken not to strip the threads in the valve body or the valve must be scrapped. And after seats have been removed, facing and fitting new rings to a tight seat is expensive and time consuming.

New rings can be inserted in a Fairbanks *Renewable* Iron Body Gate Valve by one man in from 10 to 30 minutes—depending on the location and size of valve—without removing it from the line.

Therefore it saves enough time and money in one or two renewals to pay for itself.

You can get Fairbanks Valves from distributors in any large city.

Write for Catalog No. 21.

Valve illustrated is Fig. 0340

THE FAIRBANKS COMPANY

Valves, Dart Unions, Hand Trucks and Wheelbarrows

Executive Office: 399 Lafayette St., New York, N. Y.
Boston, Pittsburgh—Distributors in Principal Cities
Factories: Binghamton, N. Y., Rome, Ga.

Fairbanks Renewable Valves

"The justification for this undertaking is that by showing what is still uncertain and unknown, it provides a new starting point for supplying the engineer with the metal best fitted for each of his multifarious purposes," Dr. John Johnston, director of research of the United States Steel Corporation, says in a section of the report describing the alloys of iron investigation.

The results of an arch dam investigation, which included the building of an experimental dam on Stevenson Creek, about sixty miles east of Fresno, Calif., "have had a far-reaching influence on the design of dams, both arch and gravity", the report declares. The investigation developed instruments and methods of test which have been employed in practically all dams of recent construction.

Research in the fatigue of metals, sponsored by the Foundation and the National Research Council, were carried out at the University of Illinois under the direction of Professor H. F. Moore. "The results of this work have been far-reaching, not only with respect to the factual data developed but in the stimulation of similar research work in the United States and several other countries," the report points out. "The work stands as the first of the later researches on fatigue phenomena, and has contributed greatly to our knowledge of the endurance characteristics of some of the most commonly used of the structural metals."

Other Foundation researches which have contributed to the progress of science, engineering, and industry embraced welding, personnel research, concrete and reinforced concrete arches, steel columns, earths and foundations, plastic flow of concrete, hydraulics, mining methods, blast furnace slags, barodynamics, thermal properties of steam, lubrication, fluid flow, effect of temperature on properties of metals, cutting metals, plasticity of metals, dielectric absorption, and engineering education.

Ambrose Swasey made five gifts to the Foundation totaling $818,600, the report discloses. Gifts by Edward Dean Adams, Henry R. Towne, W. S. Barstow, and Sophie M. Gondron amount to $131,600, and nine others have given $29,600. The book value of the endowment fund is given as $990,000. A bequest by E. H. McHenry, in the hands of executors during the life of two beneficiaries, was appraised in 1931 at $400,000.

Smoke Inspector Reports

AS PART of their work last year, Hudson County smoke inspectors made 8405 plant visits, stated William G. Christy, smoke abatement engineer of Hudson County, New Jersey, in releasing a section of his annual report. In commenting on this, Mr. Christy stated that most of the real work of smoke abatement is done during these plant visits. The quickest way to stop smoke is for an inspector to call at a plant where smoke is being made, ascertain the cause of the trouble and see that the smoke is stopped.

Continued on Page 120

When high initial pump efficiency is based on close clearances between case and impeller rings, excessive wear causes a quick drop in efficiency, a quick rise in power consumption . . . Warren pumps protect against these losses. Liberal clearances (.015″ to .030″) insure highest practical efficiencies and low power costs over long periods. Case rings have broad faces and bearing surfaces are large to keep down wear. Correct design assures easy access to stuffing boxes . . . Shafts are heavy to guard against deflection . . .

For the protection of pump buyers, Warren gladly furnishes full information on these important *design facts* as a *sound* basis for lowest pumping costs per year—year after year. A Warren proposal is never a compromise.

WARREN PUMPS

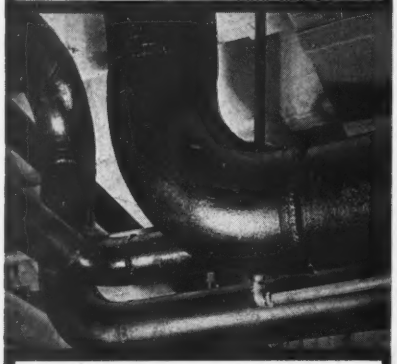
WARREN STEAM PUMP CO., INC.
WARREN, MASSACHUSETTS

7277

Ask About **WARREN'S** *"Pump Audit"*

A new service to pump users, Warren's "Pump Audit" is a new straight-forward method of getting the real facts on pumping economy in your plant, and a basis for planning pump replacement that will *pay its way*. Write for full information.

Insist on these
EIGHT FEATURES



—the welder knows their value

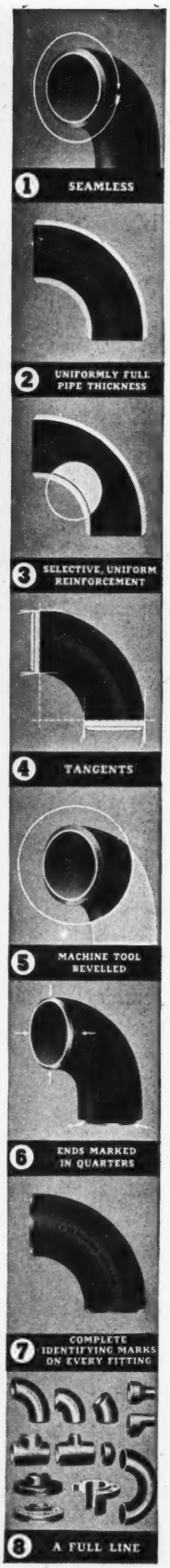
THE eight features of WeldELLS, illustrated here, do their own talking to the man who does the welding. There is no hunting for fittings, or "sizing up", because the name, size and weight are rolled into every Taylor Forge Fitting. Lining up is made easy by the quarter-markings at the ends. Welding is a quick, gratifying job thanks to the ample tangents, the clean, machine-tool bevels and the uniform accuracy of these engineered fittings.

The finished job is better too—because it is made with fittings in which all walls are at least full pipe thickness with selective reinforcement in regions where greatest strain occurs.

Ask for latest bulletin.

TAYLOR FORGE & PIPE WORKS
General Offices and Works: P. O. Box 485, Chicago
New York Office: 50 Church St.

TAYLOR FORGE
WeldELLS
Seamless Pipe Fittings for Welding


1 SEAMLESS
2 UNIFORMLY FULL PIPE THICKNESS
3 SELECTIVE, UNIFORM REINFORCEMENT
4 TANGENTS
5 MACHINE TOOL BEVELLED
6 ENDS MARKED IN QUARTERS
7 COMPLETE IDENTIFYING MARKS ON EVERY FITTING
8 A FULL LINE

Smoke inspectors also investigated 242 complaints, gave 1646 firing instructions and made 10,893 calls in the performance of their duties. Seventy-one plants or buildings, which formerly smoked, were cleared up during the year. After being watched over a period of several months, these seventy-one stacks were listed as cases cleared.

Permanent improvements during the year included 1018 oil burners, 20 mechanical stokers, 25 gas burners, 55 stack extensions, 30 steam-air jets, 68 fuel changes and 33 indicators.

"The Industries of Hudson County, New Jersey, have made an excellent showing in smoke abatement", according to William G. Christy. During the year 1939, county smoke inspectors made 26,325 observations of stationary plant chimneys and saw only 118 violations of the smoke ordinance. The violations constituted only 0.45 per cent of the observations. During the year 1931, the first year the Department of Smoke Regulation was in operation, there were 547 stationary plant violations out of 5987 observations. This figures out as a 92 per cent improvement during the year 1939, as compared with 1931.

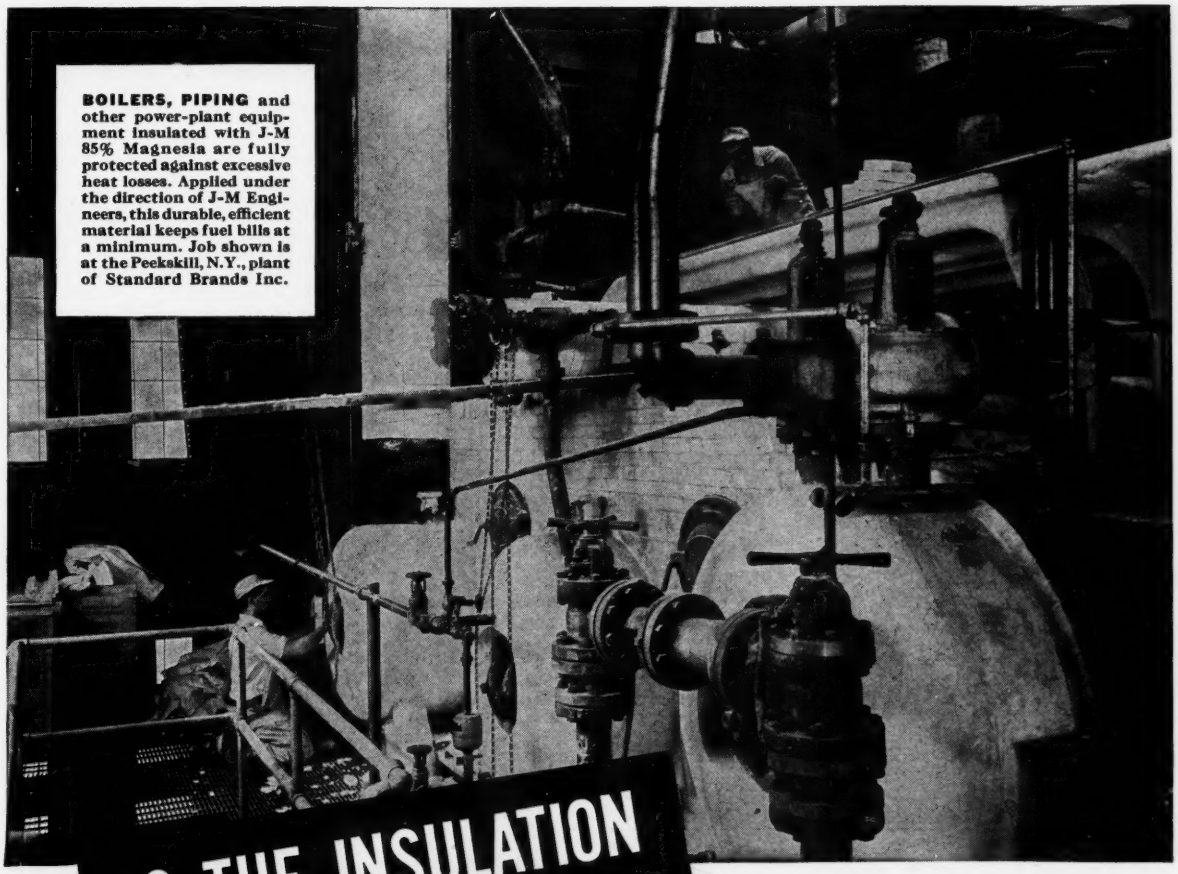
Total stack observations on railroads, industries, heating plants, floating equipment, dumps and portable equipment, amounted to 44,799. Violations observed totaled 291, or 0.65 per cent. There was less than 1 violation per day throughout the year. During the year 1931, there were 1702 violations out of 13,436 observations. This figures out as an improvement of more than 94 per cent.

All the records made by the Department of Smoke Regulation indicate that over 90 per cent of the smoke formerly made in Hudson County has been eliminated. This has all been accomplished by cooperation. Owners and operators of industrial plants, locomotives and marine vessels have cooperated wholeheartedly in most instances. This has not only eliminated a lot of smoke, but has resulted in saving large amounts of fuel for the fuel users of the county.

MOST SIGNIFICANT of recent alloys to emanate from the Westinghouse Research Laboratories is K-42-B, stronger than any known steel, containing only 7 per cent iron—yet retaining its strength at temperatures higher than 2000 degrees Fahrenheit.

As a result of almost 7 yr. of work by Westinghouse Research Metallurgist P. H. Brace, an alloy known as K-42-B has been developed which is stronger at 1100 deg. than ordinary low carbon steel is at room temperature and has a low damping coefficient—or in other words, it retains its elasticity—at such elevated temperatures.

Almost half of K-42-B is nickel; about a quarter is cobalt. But it has other components including chromium, titanium, and iron. Production of the metal on a commercial scale is known to be practical, but its first cost will be high, and its immediate uses are expected to be those of a special-purpose alloy for dies, valves, steam fittings, possibly turbine blades, or other applications requiring temperature-resistant metals. It is reported that the new alloy "creeps" a great deal less than other metals in its class.



BOILERS, PIPING and other power-plant equipment insulated with J-M 85% Magnesia are fully protected against excessive heat losses. Applied under the direction of J-M Engineers, this durable, efficient material keeps fuel bills at a minimum. Job shown is at the Peekskill, N.Y., plant of Standard Brands Inc.

IS THE INSULATION IN YOUR PLANT ONLY HALF RIGHT?

ALMOST any insulation will save you some money on fuel. But to get fuel costs down to rock bottom . . . and to keep them there . . . it takes the *one correct insulating material*, applied in the *one most economical thickness*.

To assure every saving possible with insulation, leading power plants rely on the J-M Insulation-Engineering Service. J-M Engineers bring to your plant specialized technical experience and training that enable them to trace down sources of costly heat loss that might otherwise go unnoticed. Because they work with the complete J-M line of insulations, they can recommend the exact amount of the right insulation for your particular problem . . . help you make sure that your insulation investment pays maximum returns.

Whether you are planning on installing new power-plant equipment or interested only in checking heat economy on existing equipment, it will pay you to investigate this free J-M service. For complete information and data on all J-M Industrial Insulations, write for Catalog IN-55A. Johns-Manville, 22 East 40th Street, New York, N. Y.

Johns-Manville INDUSTRIAL INSULATIONS

FOR EVERY TEMPERATURE . . . FOR EVERY SERVICE . . .

Superex . . . 85% Magnesia . . . Asbesto-Sponge Felted . . . Sil-O-Cel . . . Marinite . . . Anti-Sweat . . . Rock Cork

News from the Field

E. C. SAMMONS, President of the Stoker Manufacturers Association, announces the appointment of the following members to serve on the Annual Meeting Committee: J. M. McClintock, Chairman, Illinois Iron & Bolt Co.; H. L. Bilsborough, Fairbanks, Morse & Co.; C. M. Lewis, Anchor Stove & Range Co.; and John Munro, Whiting Corp.

FRANK A. CHAMBERS, Chief Smoke Inspector of the City of Chicago, in his monthly report shows that permits for 71 installations of heating equipment were issued by the City during the month of February. Fifty-nine permits were issued by the Smoke Department for underfeed stokers; 8 for oil burners; 2 hand-fired boilers under fuel agreements; 1 chain grate stoker; and 1 incinerator. Permits issued by the City cover installations in commercial and larger structures only.

THE 27TH SPRING MEETING of The American Society of Refrigerating Engineers, featuring the newest developments and practical information in commercial and industrial refrigeration and in air conditioning, will be held at Skytop Club, Skytop, Pa., June 9, 10, 11.

THE 14TH NATIONAL EXPOSITION of power & Mechanical Engineering, better known as the National Power Show, will be held December 2 to 7 at Grand Central Palace, New York. This biennial exposition brings together the product displays of over 300 leading manufacturers serving the power field, and is widely attended by power engineers, operating men and executives.

THE NATIONAL ASSOCIATION OF FAN MANUFACTURERS announces the election of E. Szekely, President; H. Mathis, Vice President; and L. O. Monroe, Secretary-Treasurer for the ensuing year.

THE FEDERAL POWER COMMISSION has determined the actual legitimate original cost of the Safe Harbor Water Power Corporation's hydroelectric project on the Susquehanna River, in Pennsylvania, as of December 31, 1937, to be $27,919,515.88.

New Engineering Building at U. S. C.

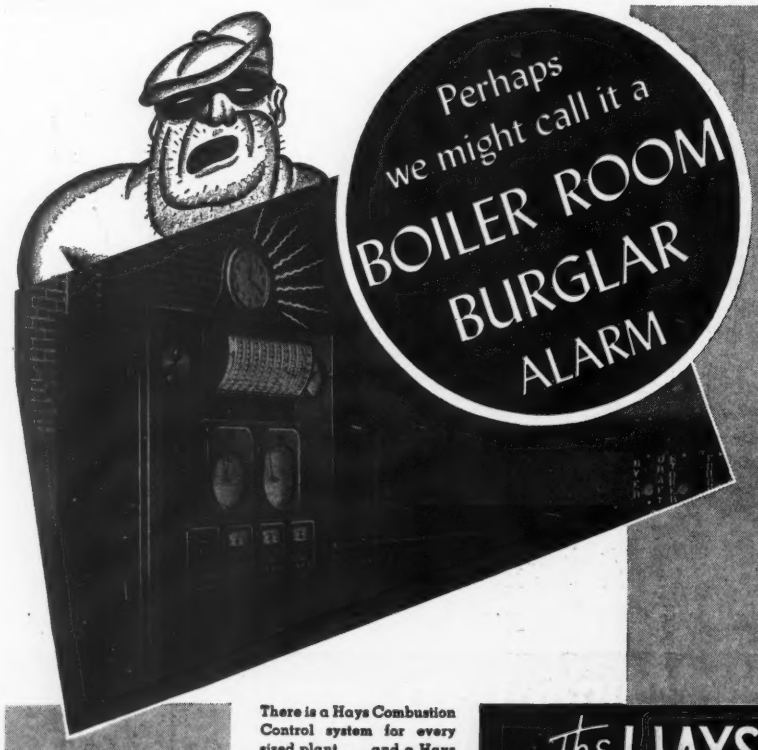
IN ORDER to meet the needs of a 50 per cent increase in student attendance during the past three years, a new $125,000 wing to a proposed College of Engineering building was recently completed on the University of Southern California campus. Dean Philip S. Biegler says that the engineer enrollment increased from 250 in 1937 to a total of 385 at present. The new four story concrete structure includes 27.000 sq. ft. of space and is equipped for class room and laboratory instruction.

Smoke Prevention Association

THE 34TH ANNUAL CONVENTION of the Smoke Prevention Association will be held at the Hotel Statler, St. Louis, Mo., May 21st to 24th. Among the papers to be read at the various sessions are the following: Smoke Index: A Quantative Measurement of Smoke, by Robt. J. Piersol, Illinois State Geological Survey; The Law as Applied to Air Pollution, by Ralph Johansen, President, Hays Institute of Combustion.

One of the outstanding features on Wednesday's program will be a panel discussion entitled: Hand Firing Heating Equipment with Different Kinds of Coal, and the following will participate: D. H. Williams, District Manager, Coal Bureau, N. & W. Ry., Cincinnati; J. E. Tobey, Manager, Fuel Engineering Div., Appalachian Coals, Inc., Cincinnati; Vernon Leach, Peabody Coal Co., Chicago; George Ritchie, Fuel Service Engineer, C. & O. Ry., Richmond, Va., and Stewart Orgain, Consulting Engineer, Chicago Coal Merchants Association, Chicago. Wm. G. Christy, Smoke Abatement Engineer, Hudson County, N. J., will act as chairman during a panel discussion on Railroad Locomotive Smoke Abatement. H. K. Kugel, Chief Engineer, Division of Smoke Regulation and Boiler Inspection, Washington, D. C., will preside over a conference of City Smoke Inspectors.

At the meeting an innovation is being attempted in the form of a conference of smoke enforcement officials of various cities.



EXCESS AIR, the thief in the boiler room, is always snooping 'round looking for a chance to snitch some of that costly fuel.

Hays automatic combustion control and instruments effectively throttle this menace. Air and fuel are accurately measured to meet the demand and guard against loss. Regardless of fluctuations steam pressure is kept constant without waste. Fuel is consumed only when needed and the correct amount of air supplied to maintain the most efficient combustion under all load conditions. Write for complete information.

There is a Hays Combustion Control system for every sized plant . . . and a Hays representative near you to tell you all about it. Write the Hays Corporation, 910 Eighth Avenue, Michigan City, Indiana

THE HAYS CORPORATION
SINCE 1907
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

New Construction

A NEW boiler house, desingned by Lockwood Green Engineers, Inc., of New York, is now under construction which will supply process steam, service water and compressed air to the Rubber Reclaiming and Chemical Manufacturing Plants at Naugatuck, Conn.

The building is of concrete structural steel and brick construction and is approximately 90 ft. long, 66 ft. wide and 70 ft. high. It will contain three Babcock & Wilcox Stirling type boilers, 275 lb. pressure, 60,000 lb. per hr. capacity each, with economizer and air heater for each unit. The boilers will be fired by Westinghouse continuous dump stokers. A complete system of coal and ash handling equipment will be installed by the Link-Belt Co. M: W. Kellogg will build the radial brick chimney 175 ft. high.

Alabama Power Company Begins Work on New Station at Mobile

THE ALABAMA POWER CO., Birmingham, Ala., has begun construction of a new steam-electric generating station at Chickasaw, a suburb of Mobile, Ala., to supplement an existing small plant at that place. A contract for piling has been awarded to the Ernest Construction Co., Mobile, and for steel frame superstructure to the Virginia Bridge Co., Roanoke, Va. Concrete bases, slabs and walls will be built by Foster & Creighton Co., American National Bank Building, Nashville, Tenn. New station will be equipped with steam turbine units for an initial capacity of 32,000-kw., which with present Chickasaw plant installation of 8000-kw., will provide a total rating of 40,000-kw.; high-pressure boilers and auxiliary steam plant equipment; large switchyard structure and other operating facilities. An appropriation of about $4,000,000 has been arranged for the plant, which is scheduled for completion in 1941.

Philadelphia Electric Co. to Expend $15,301,000 on Properties

THE PHILADELPHIA ELECTRIC CO., Philadelphia, Pa., has authorized an appropriation of $15,301,000 for expansion and improvements in plants and system during 1940. Of this amount approximately $14,415,000 will be expended in the electrical department, including power plants, transmission and distributing lines, power substations and switching stations, and other facilities. For the steam division, a fund of $116,000 is made available, covering work to be carried out in the steam department at different generating stations, comprising boilers, pumps and accessory equipment. The budget provides for an expenditure of $770,000 for the gas division, including station facilities, pipe lines, service connections, etc. The 1940 appropriation is more than twice the amount authorized last year, which totaled $6,941,000.

New Hydroelectric Station at Cedar Falls, Iowa

THE CITY COUNCIL, Cedar Falls, Iowa, has asked bids for construction of a proposed new municipal electric power plant on site at the terminus of State Street, and work on project is scheduled to begin this spring. The new station will replace an existing steam-electric plant, operated for some years past, and it is estimated that approximately $9,800 will be saved annually with the use of the hydroelectric power development. The station building will be 34 x 80 ft., with installation to include two hydraulic turbines with generating units and accessories, estimated to cost approximately $75,000, capable of furnishing 5,000,000 kwh. per annum; foundations and tailrace structure will represent an estimated investment of $10,000, with building and stationary equipment to cost approximately $100,000, including switchboard panels, voltage regulators, switchgear and auxiliary apparatus. Clark H. Streeter is city engineer, in charge.

California-Oregon Power Company Authorizes $10,000,000 for Expansion

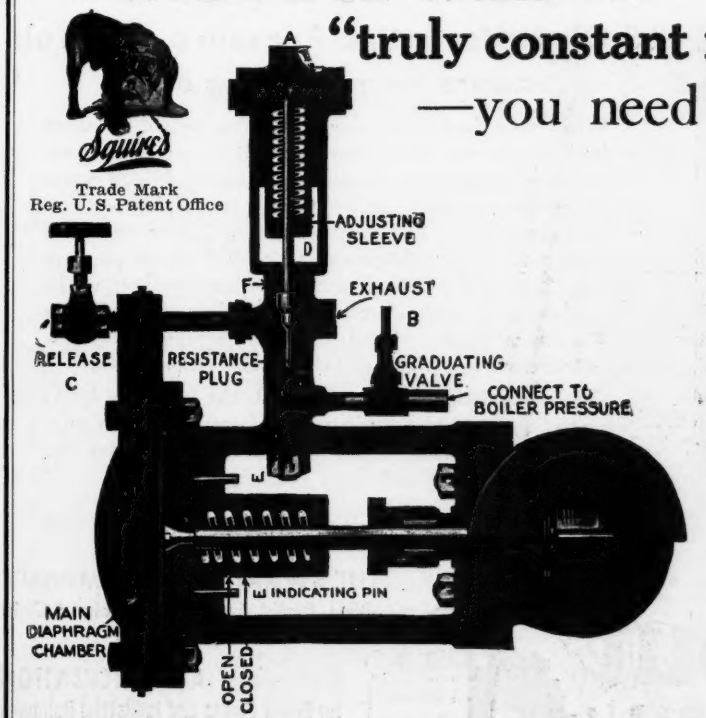
THE CALIFORNIA-OREGON POWER CO., Medford and Grants Pass, Ore., has arranged a fund of $10,014,000 for expansion and improvements in properties during the present year, and will begin work on different features of the program at once. Extensions and improvements will be made in generating stations and facilities, with installation of additional equipment. A new switching station will be

When You Want—

"truly constant reduced pressure"

—you need the GENUINE

Squires



Squires

Reducing Valve

It will reduce any initial boiler pressure up to 500 lb. down to atmosphere in a single operation and will hold it without a quiver.

The reduced pressure remains constant regardless of pressure fluctuations on the initial side. Functions with an independent pilot valve that can easily be adjusted to maintain the desired reduced pressure.

Send Now for Catalog E-10½

The C. E. SQUIRES CO.

E. 40th St. and Kelley Ave.
CLEVELAND, OHIO

built at Klamath Falls, Ore., to cost approximately $65,000, with equipment; the Gold Ray power dam on the Rogue River will be rebuilt at estimated cost of $38,000. Several new transmission lines will be constructed, as well as the rebuilding of a number of existing lines. These will include a line from Medford to Grants Pass to cost about $150,000; rebuilding of line between Klamath Falls and Enterprise, and certain lines in Northern California, to cost approximately $30,000. A part of the appropriation will be used for extensions and betterments in water systems in different communities, to cost over $100,000 of the gross amount noted.

Tongue Point Air Station Power Plant

AN APPROPIATION of $1,500,000 has been made for work to be carried out this year at the new Naval Air Station, Tongue Point, Ore., for which call for bids will be handled by the Public Works Officer, Puget Sound Navy Yard, Bremerton, Wash. The program includes a new power plant, with initial installation of two 150-hp. boilers and accessory equipment; steam distribution system, totaling about 2400 ft. of steam and return lines in concrete ducts; and electric distributing system for furnishing power to different buildings at this new seaplane base. Work will be carried out under Specifications 9484. Also, two underground steel fuel tanks, each about 10,000-gal. capacity; five underground gasoline tanks, each 10,000-gal. capacity; hangars, storehouses, two magazine structures and miscellaneous work. The Puget Sound Bridge & Dredging Co., Seattle, Wash., has active work in progress for the dredging of a channel for a seaplane runway at the station, for which contract was let last November.

Manufacturers' News

ROBINS CONVEYING BELT CO. has built a three story brick office building to house its Executive, Engineering, Sales and other departments, where they can be in closer touch with the manufacturing facilities to the advantage of clients, as well as themselves. The new address, Passaic, N. J.

IT HAS been announced that Charles M. Chapman is now a representative of Cochrane Corp. in the Cincinnati territory covering parts of Ohio, Indiana, and Kentucky.

THE FOSTER WHEELER CORP., 165 Broadway, New York City, announces the appointment of P. W. Foster, Jr., as manager of its Steam Division. Martin Frisch, formerly Chief Engineer of the Steam Division, has been appointed Chief Engineer of Foster Wheeler Corp.

WILLIAM B. DOBSON for many years superintendent of the heating boiler division of the Struthers-Wells Titusville Corp., has been appointed works manager of the Oil City Tank and Boiler Company of Oil City, Pennsylvania.

A. WHITON VENNEMA, Mechanical Superintendent of The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., died at his home in Ridgewood, N. J., on March 23. He was born May 13, 1887, in Kalamazoo, Mich., and graduated from Stevens Institute of Technology with the class of 1909 with the degree of mechanical engineer. He had been associated with Manhattan Rubber for 31 yr. Mr. Vennema is survived by his wife and two sons.

THE FAIRBANKS CO. has opened a a warehouse at 548 M. & M. Building, Houston, Texas, where they will carry a complete stock of Fairbanks Bronze and Iron Valves and Dart Unions to enable them to make prompt deliveries in that territory.

THE MCKENNA METALS CO., Latrobe, Pa., has awarded a contract to the Blaw-Knox Co. for the construction of a new research laboratory to be used for the development of new applications of Kennametal and for the investigation of new intermetallic compounds. The building will be of steel construction with insulated ceiling and roof.

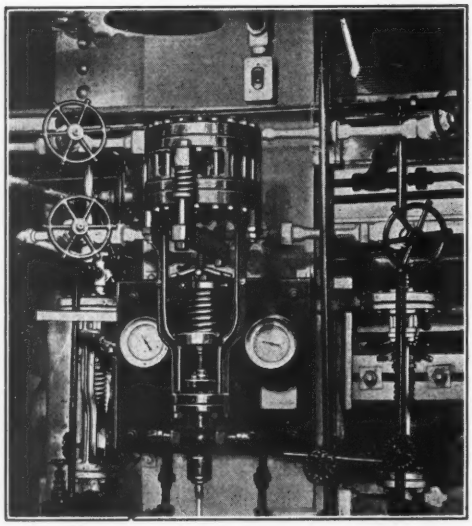
A. B. APPLEBAUM, Vice-President and Secretary of The Permutit Co., has been elected a Director, it has been announced by W. Spencer Robertson, President. He has been with The Permutit Co. for more than 25 yr., during many of which he was Technical Manager before becoming Vice-President.

T. M. DEAL, President, Link-Belt Speeder Corp., announces the appointment of Hayes Parsons as Sales Manager. Mr. Parsons has an unusual background of manufacturing, managament and marketing experience.

Keep Pumps from Running Wild *with* Swartwout—

"S-C" Differential Pressure Controls

Assure lower operating cost



When your feed water set-up involves control of boiler feed pumps, use Swartwout Controls to regulate excess pressures automatically—insure even steady flow of water to boilers, prevent costly damage to piping system. Swartwout "S-C" Differential Pressure Master Regulator starts and stops feed pumps to control excess pressure when signalled by drum and feed line pressure; works harmoniously with Swartwout's efficient Feed Water Regulation System. Used for years on pressures as low as five ounces—as high as 1450 pounds steam pressure.

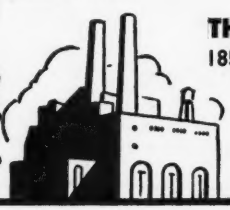
Swartwout designs, engineers, builds the necessary hook-up to fit your needs—a worry-free system that saves operating troubles and repair expense. Write today for Bulletin S-20-D.

Left—Differential Master, 900 lb. Standard, controlling three B-F pumps at Weirton Steel Co., Weirton, W. Va.

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment•



THE SWARTWOUT COMPANY
18541 Euclid Avenue • Cleveland, Ohio

* * *

Controlled **AIR CIRCULATION**
for Power Plants and Industrial Buildings

A NEW BOARD of Directors was elected by representatives of the producing companies affiliated with Appalachian Coals, Inc., at their annual stockholders' meeting held in Cincinnati, O., during the first week in April. The new Board in turn selected the following officers: R. E. Howe, president; A. L. Brown, vice-president; and W. M. Wilshire, secretary and treasurer, all re-elected. J. E. Tobey, vice-president, and L. E. Jamison, assistant secretary and assistant treasurer, newly-elected officers. Mr. Brown was reappointed as Manager, Marketing Division; Jamison as Comptroller; and Mr. Tobey as Manager, Fuel Engineering Division. T. A. Day, formerly assistant secretary, was reappointed as Manager, Southeastern Office, Knoxville, Tenn.

FRANK GRIESING has been added to the staff of the J-B Sales Engineering Co., New Haven, Conn. The company has been appointed Connecticut Engineering Representative for the Worm Gear Division of the De Laval Steam Turbine Co.

LINK-BELT Co. announces the stoker division's sales and service quarters in the city of Detroit have been moved to a new and better location, with James G. Cunningham in charge. The new address is 2885 East Grand Blvd., at St. Antoine St.

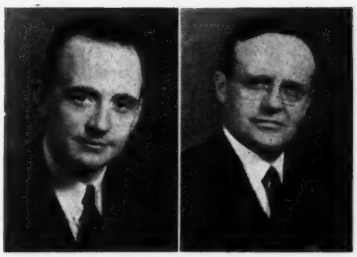
WALTER F. KEENAN, JR., Director and Vice President in Charge of Engineering of Foster Wheeler Corp., 165 Broadway, New York, died at his home in Pelham Manor, N. Y., on March 18 at the age of 54 yr. He graduated from the mechanical engineering course of the University of Pennsylvania in 1908 and has worked in an executive capacity in the Foster Wheeler Corp. since it was formed in 1927.

A. J. WADHAMS, Vice President and Manager of the Development and Research Division of The International Nickel Co., Inc., announces that F. L. LaQue, who has been Assistant Director of Technical Service on Mill products is now engaged in development activities on all applications of both ferrous and nonferrous nickel-containing alloys. Dr. William A. Mudge has been appointed Assistant Director of Technical Service to succeed Mr. LaQue.

Crowther and Mahan Advanced in G. E. Lighting Division

F. D. CROWTHER AND H. E. MAHAN have been named managers respectively, of the lighting sales section and the illuminating laboratory section of the lighting division of the General Electric Company, it has been announced by A. F. Dickerson, lighting division manager.

After graduation from Oregon State College in 1927 with a B.S. degree in electrical engineering, Mr. Crowther joined G. E. on the test course at Schnectady. In 1928 he entered the illuminating engineering laboratory, became a lighting engineer, and continued in that capacity until 1930. Upon leave of absence in that year, he became engineer of the Outdoor Sports Illuminating Co. While there he designed the plan for the first lighting system in the minor baseball leagues, at Des Moines, Iowa. Returning to the G. E. illuminating laboratory in 1932 he entered the commercial section, specializing in street lighting. Since January, 1939, he was commercial assistant to the lighting sales manager.



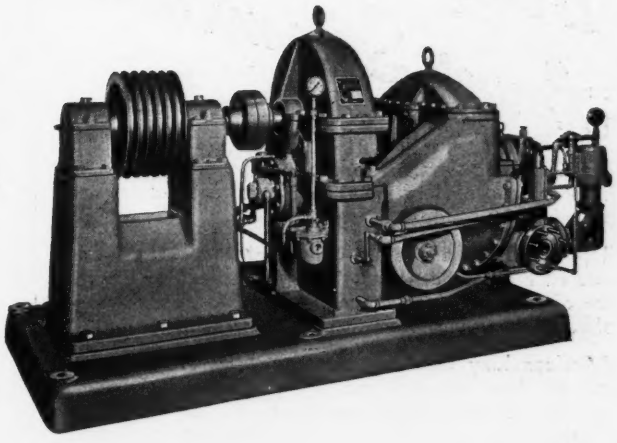
F. D. Crowther H. E. Mahan

Mr. Mahan entered the General Electric "test" in 1910, becoming a member of the illuminating laboratory in the same year. He had been previously employed by the Philadelphia Rapid Transit Co. after graduating from Drexel Institute of Technology in 1909 with a B.S. degree in electrical engineering. In 1915 Mr. Mahan assisted in the lighting of the Panama-Pacific Exposition, and since that time has been closely associated with the exposition illumination at the Century of Progress in Chicago and the Golden Gate International Exposition in San Francisco.

In 1929 Mr. Mahan acted as advisor to the Chilean and Venezuelan government when he visited those countries to recommend lighting of airports. He was appointed assistant manager in charge of engineering at the illuminating laboratory in 1932, the position he held until his recent appointment.

MURRAY TYPE "UG" TURBINES

PICTURED here is a 75 hp. MURRAY Type "UG" Turbine adapted for "V" belt drive and using a direct acting variable speed hydraulic governor. This unit is being used in a meat packing plant to drive a reciprocating ammonia compressor.



Our Type "UG" Turbines are adaptable to many purposes and our engineers and representatives will be glad to cooperate with you on your problems.

MURRAY IRON WORKS COMPANY, BURLINGTON, IOWA.

For the Engineer's Library

Recent bulletins and catalogs on power plant equipment listed for your convenience in securing specific information. Power Plant Engineering will be glad to procure for you any free literature that you desire.

Internal Combustion Engine

Sand-Banum Special, a simple method of keeping radiator cooling systems of Diesel engines clean, free from scale and rust, is described in a new 6-page pocket size folder. Instructions for using the product are included in the folder. The American Sand-Banum Co., Inc.

Steam Specialties—Heat Recovery from Internal Combustion Engines is the title of a new 16-page bulletin illustrating and describing the use of Sims equipment with Diesel and Gas Engines. The bulletin features a wide variety of installations in the U. S. A. The Sims Co.

Engineers Piston Ring Handbook—This 158-page book is a practical manual giving recommended types, specifications and applications of piston rings for machine designers and operators. American Hammered Piston Ring Division, Koppers Co.

Gas Engine—Worthington Gas Engines of the vertical four-cycle type having a 25-in. stroke are illustrated and described in Bulletin S-550-B7 giving dimensions and specifications. Worthington Pump and Machinery Corp.

Valves

Hancock Steel Valves—The new 40-page Bulletin No. 5-7000 contains complete dimensions of all types of valves, and also complete material specifications of all metals used in the valves. In addition, the bulletin contains pages reproducing in full the A. S. M. E. Service rating tables. Information on the Hancock Duravalve and Bar Stock Valve is also included. Manning, Maxwell & Moore, Inc.

Valve Reseating Machines — Catalog 40 illustrates and describes a number of Dexter valve reseating machines covering operation specifications and sizes. Machines for reseating gate, globe and pump valves are completely covered in the catalog. The Leavitt Machine Co.

Benders — This bulletin, No. 40E, contains latest information on Parker Fabricating Equipment, including power benders, manually operated production tube benders and production bending jigs. Accessories and price lists and correct flaring data are also given in the bulletin. The Parker Appliance Co.

Valves — Reference Book No. 38 superseding all previous issues illustrates and describes all valves and other Homestead products giving dimensions, weights and prices. Construction and application are also concluded in this 48-page book. Homestead Valve Mfg. Co.

Boilers and Furnaces

Cross-Drum Boiler—A 16-page bulletin, No. G-28, describing design 32 Cross-Drum boiler for pressures of 250 lb. or less; and with heating surfaces from 1000 to 6000 sq. ft. In addition to presenting the advantages of this boiler, the text is an interesting discussion of the effect of straight-tube, cross-drum design on the cost of the unit, complete and ready for service; and the ease of inspection, cleaning and similar routine operations. The Babcock & Wilcox Co.

Fire Brick—A new folder describing high heat duty fire brick has been issued by the A. P. Green Fire Brick Co.

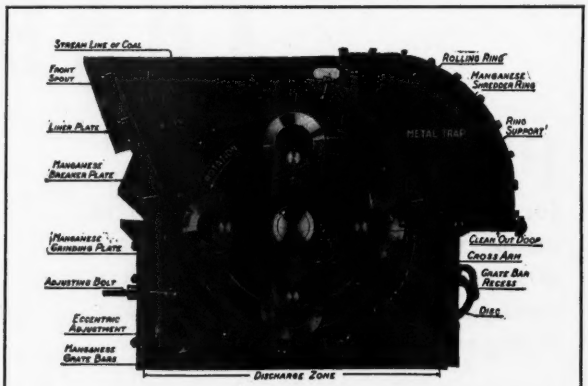
Stoker—A new 25-page bulletin, No. 600, gives a complete treatise on the Detroit UniStoker covering construction, operation, application. The bulletin is well illustrated with photographs and line drawings. Detroit Stoker Co.

Use AMERICAN RING CRUSHERS FOR *Better Coal Sizing Lower Steam Costs*

American Ring Crushers reduce in one operation run-of-mine or lump coal to the proper sizes required for unit pulverizers and automatic stokers.

Reports from many users show that the better sizing assured by American Ring Crushers makes possible the use of a wider range of coals—improves combustion—effects fuel savings from 2½ to 8 per cent.

American Ring Crushers have capacities of 25 to 500 tons per hour, are built special for each installation and guaranteed for definite performance. Let American Crusher engineers cooperate in meeting your coal sizing needs.



Above: Cross-sectional view of American Ring Crusher. Right: Patent shredder rings split coal in uniform size instead of crushing it—a patented "American" feature.

AMERICAN PULVERIZER COMPANY
1429 Macklind Avenue
St. Louis, Missouri
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

Electrical Equipment

Electrical Equipment—Four bulletins treating various types of electrical equipment. The titles and numbers of the respective bulletins are as follows: Bulletin GEA-1412B, Vertical Solid-Shaft Induction Motors; GEA-1368D, Vertical Hollow-Shaft Induction Motors; GEA-3223, Single-phase Vertical Motors; GEA-3301, G-E Reactrol System. General Electric Co.

Air Circuit Breakers—Bulletin No. 3912 is an 8-page illustrated booklet on Type ET-20 Circuit Breakers, giving construction, application and engineering data. I-T-E Circuit Breaker Co.

Colorimeter—A new 6-page folder gives a complete description of the Lumetron Photoelectric Colorimeter. Following the introduction containing the general description, the balance of the text is divided into subjects covering such topics as Optical System, Electrical System, Galvanometer, Slide Wire, Photo Cells, Lamp Adjustment, Operation, Sample Holders. Measurement of Dark and Pale Liquids and Use of Color Filter. Photovolt Corp.

Pumps and Compressors

Centrifugal Blowers and Compressors is the title of a new book which covers: Construction of centrifugal blowers and compressors and their characteristics; turbine and motor drives; governing; properties of gases and laws of compression; selecting a compressor for given conditions and calculating the horsepower, and calculating pressure drop in piping. De Laval Steam Turbine Co.

Pumps—An automatic priming system for centrifugal pumps, which keeps the pump always filled with water and eliminates need for attention from operators, is described in a paper by F. S. Broadhurst, which has been reprinted and is being distributed by the De Laval Steam Turbine Co.

Pump—Bulletin W-341-B7 illustrates and describes the Type HL Worthington vertically split-single stage volute centrifugal pump. Capacities, heads, speed and dimensions of the equipment are included in the bulletin. Worthington Pump and Machinery Corp.

Mechanical Power Transmission

Rubber Bearings—A new 62-page booklet on the Cutless bearings has just been issued covering operating problems, efficiency, adaptability and recommendations for installation, operation and lubrication. Tables on dimensions and weights, together with diagrammatic treatment are included in the bulletin. Lucian Q. Moffit, Inc.

Belting—Two new 4-page pocket size folders have just been issued describing Tannate Watershed Leather belting. J. E. Rhoads & Sons.

Miscellaneous

pH Meters—Four page Bulletin M-381 illustrates and describes the Thwing-Albert Portable pH Meters, including features, operation, application. The bulletin also includes a treatise entitled pH and How It Is Measured. Thwing-Albert Instrument Co.

Separators—A new 8-page Bulletin, Publication 2950, on baffle-type moisture and oil separators contains cross-section photographs and line drawings of the three popular types of line separators. Complete design, dimension, and constructional data is given with list prices. Data on proper drainage, gage fittings, and auxiliary equipment is also given. Cochrane Corp.

Condenser Tubes—Descriptive literature concerning the C&C Tube Extraction Method for Steam Condensers and Heat Enchangers covers Tube Cutting, stretching and pulling. C & C Corp.

Radiant Heating—This new 24-page bulletin presents a non-technical discussion of radiant heating and reports modern practice in installing such systems, covering theory, application and design. Selection of pipe for radiant heating installations is described in detail. A. M. Byers Co.

Uses and Properties of Seven Metals—This sixteen-page, pocket size edition of a new publication entitled Seven Minutes With Seven Metals, includes material on Nickel, Monel, Inconel, and associated alloys in both mill and clad forms. Space is also devoted chanical, chemical, and physical charto the properties and uses of the metals in cast form. Detailed tables on meacteristics are included. The International Nickel Co.

Cranes—A new bulletin No. LCC-1, describes the crawler crane method of material handling. The advantages cited in the bulletin apply to all crawler cranes now manufactured by some 30 different companies. Bucyrus-Erie Co.

OTHER SERVICES TOO

EVERLASTING
Model W
Figure 1000

EVERLASTING VALVES are so well known as efficient boiler blow-off valves, as to lead one's thoughts into that field of service only. However, they do splendid work in many Other Developments, especially at the ends of lines, where leaks are expensive or hazardous.

Then, too, where Time is a factor in opening and closing a valve many times in process Work, our quarter-turn operation fills the bill splendidly and EVERLASTING VALVES DO STAY TIGHT.

The EVERLASTING VALVE today is much better than formerly. One feature is our springs. Today we have SPRINGS OF INCONEL, which has properties practically equal to those of Steel as go springs, but the added value of being corrosion resistant.

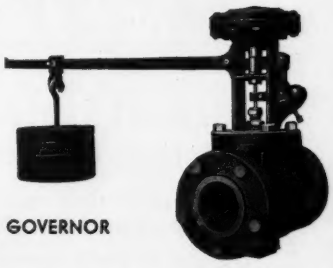
THE EVERLASTING VALVE is needed in every kind of Service where a DROP-TIGHT-SEAL Quick Opening is desired in handling Steam, Water, Air, Oil, Tar, Gas, Gasoline, Acids, Etc.

Write for Bulletin E-45A

EVERLASTING VALVE COMPANY
Jersey City . . . New Jersey

In Canada: Everlasting Valve Co., Ltd., Toronto
In England: Everlasting Valve Co. (Gt. Britain), Ltd., London

Keeps a Gas-Fired Boiler at Constant Pressure



FULTON
GAS-FUEL BOILER GOVERNOR

There will be no blowing off where a gas-fired boiler is equipped with the Fulton Governor designed for such installations. Steam pressure will be maintained at any point between 1 pound and 150 pounds as desired. Operation will be regular, economical, and safe. Write for Bulletin 1182. Also Catalog of C-F Pressure Regulators.

The CHAPLIN-FULTON MFG. CO.
28-40 PENN AVE. CF PITTSBURGH, PA.

Power Plant Construction News

Ala., Fairfield — Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., a subsidiary of United States Steel Corporation, New York, plans installation of electric power equipment in connection with expansion and improvements in tin plate mill at Fairfield. Entire project will cost over $3,000,000. Proposed to begin work soon.

Calif., Burbank—Lockheed Aircraft Corporation, Empire Avenue, plans installation of electric power equipment in new one-story addition to airplane-manufacturing plant, totaling about 35,000 sq. ft. of floor space, to be known as Assembling Building No. 9. Cost estimated about $90,000. John and Donald B. Parkinson, Title Insurance Building, Los Angeles, are architects.

Calif., Newark—Leslie Salt Co., 310 Sansome Street, San Francisco, Calif., plans installation of electric power equipment in new salt refining and milling plant at Newark, where site has been selected. A power house is proposed. Entire project will cost in excess of $850,000.

Fla., Jacksonville—Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids until May 8 for power plant building at Naval Air Station, Jacksonville (Specifications 9414).

Ill., Chicago—Commonwealth Edison Co., 72 West Adams Street, is considering preliminary plans for expansion in local steam-electric power plant on Fisk Street, with installation of new 147,000-kw. turbine-generator unit and accessories, high-pressure boiler and auxiliary equipment. This will be part of general development program of company and is reported to cost in excess of $5,000,000. Completion is scheduled in 1942.

Ind., Indianapolis—Allison Engineering Division, General Motors Corporation, Speedway City, Indianapolis, plans installation of electric power equipment in new four-unit addition to airplane engine-manufacturing plant. Cost estimated over $500,000. J. Lloyd Allen, Architects' and Builders' Building, is architect.

Ind., Richmond—Board of Public Works, City Hall, plans extensions and improvements in municipal power plant, including installation of new 15,000-kw. turbine-generator unit, surface condenser and auxiliary equipment. Cost estimated at $625,000. W. R. Stevens, superintendent at plant, in charge.

Kan., Sterling—City Council has plans under way for expansion and improvements in municipal power plant, including installation of new Diesel engine-generating unit and auxiliary equipment. Bond issue of $80,000 has been authorized for work. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

Ky., Paducah—Board of City Commissioners has authorized surveys and estimates of cost for new municipal electric power plant. James P. Smith, city manager, is in charge.

La., Mansfield—W. C. Nabors Co., Oak Street, manufacturer of automobile trailers and parts, plans installation of electric power equipment in two new one-story plant additions, 50x260 ft. and 60x125 ft., respectively. Entire project will cost over $65,000.

Mass., Boston—Old Colony Gas Co., 39 Quincy Street, plans early rebuilding of gas plant in East Braintree district recently destroyed by fire, caused an explosion. Loss included compressor station, gas holder and auxiliary structures, totaling close to $500,000, including equipment.

Mass., Salem — Hygrade Sylvania Corporation, Bridge Street, plans installation of electric power equipment in new two-story addition to electric lamp and radio tube-manufacturing plant. Entire project will cost close to $200,000.

Mich., Detroit—Chrysler Corporation, 341 Massachusetts Avenue, plans installation of electric power equipment in new one and two-story addition to parts-manufacturing plant on Oakland Avenue, Highland Park, 135x575 ft. Entire project is reported to cost over $300,000. Albert Kahn, Inc., New Center Building, is architect and engineer.

MAGNOLIA METALS

Adamant Super-Genuine withstands heat and vibration

You'll save time and money by using Adamant for all bearings on Diesels, airplane and other internal combustion engines.

This top quality babbitt will not crack or check in the bearings. It stands high initial heat, strain, impact and vibration. Practically no dross loss. Widely used for connecting rods.

MAGNOLIA METAL COMPANY
120 BAYWAY, ELIZABETH, N. J.
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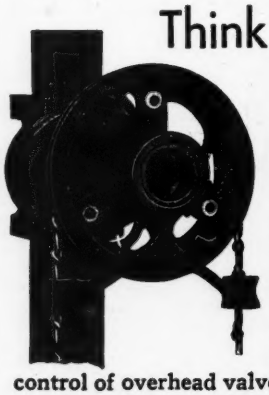

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Minn., Hutchinson—City Council is considering new municipal electric power plant, with capacity for city requirements and rural electric system in that area. Project will be carried out in cooperation with local electric cooperative organization. Proposed to use Diesel engine-generator units and accessories. Cost estimated close to $300,000. Financing will be carried out through Federal aid.

Minn., Minneota—City Council has authorized surveys and estimates of cost for new municipal power plant. G. M. Orr & Co., Baker Arcade Building, Minneapolis, Minn., are consulting engineers.

N. M., Albuquerque—City Council plans steam power house at municipal airport for central-heating service. Fund of $150,000 is being arranged through Federal aid for this and other work at airport.

N. J., Newark—Hygienic Tube & Container Corporation, 34 Avenue L, manufacturer of composition tubing, vials, etc., has approved plans for one-story boiler house and compressor station, in connection with new two and three-story addition. Entire project will cost over $125,000, including equipment.

Ohio, Cleveland—Warner & Swasey Co., 5701 Carnegie Avenue, S.E., manufacturer of machine tools, plans installation of electric power equipment in new one-story addition, totaling about 30,000 sq. ft. of floor space. Entire project will cost close to $100,000. Osborn Engineering Co., 7016 Euclid Avenue, is consulting engineer.

Ore., Eugene — Eugene Water Board, J. W. McArthur, general superintendent, will take bids soon for new steam-electric generating station, about 7500-kw. capacity, for standby service for present municipal hydroelectric power plant. Cost estimated over $500,000. R. B. Boals is engineer for Water Board; H. W. Beacher, Securities Building, Seattle, Wash., is consulting engineer.

Pa., Harrisburg — Pennsylvania Power & Light Co., Allentown, Pa., has approved plans for two additions to steam-electric power plant on Elliott Street, Harrisburg, where expansion will be carried out. Additional equipment will be installed. Entire project reported to cost over $250,000.

Pa., Mohnton—Leininger Knitting Mills, Inc., is completing plans for expansion in power house at textile mill, to include installation of boiler unit and auxiliary equipment. Cost reported close to $45,000, with equipment.

Pa., Oaks—B. F. Goodrich Co., Akron, Ohio, manufacturer of automobile tires, tubes, etc., plans installation of electric power equipment in new addition to branch mill at Oaks, for which superstructure will begin soon. Entire project is reported to cost close to $100,000. Albert Kahn, Inc., New Center Building, Detroit, Mich., is architect and engineer.

Pa., Oil City—Pennzoil Co., Inc., Drake Building, plans extensions and improvements in power house at local oil refining plant, including installation of new boiler unit and auxiliary equipment. Also will make extensions in refinery. Entire project reported to cost over $65,000.

Pa., Philadelphia—Gulf Oil Corporation, Gulf Building, Pittsburgh, Pa., plans installation of electric power equipment, steel tank storage and pumping facilities, and other mechanical equipment in connection with expansion at oil refining plant at Thirtieth Street and Penrose Avenue, Philadelphia, where large increased capacity will be developed. Power house will be enlarged. Entire project will cost close to $5,000,000.

S. D., Elkton—City Council is considering preliminary plans for new municipal electric power plant, using Diesel engine-generator units and accessories. Cost estimated about $75,000. Proposed to hold a special election soon to approve project.

Texas, Hearne—City Council has plans under way for extensions and improvements in municipal power plant and system. Bond issue of $100,000 has been authorized for this and expansion in water system.

Texas, Houston—Pittsburgh Plate Glass Co., Paint Division, Grant Building, Pittsburgh, Pa., plans installation of electric power equipment in new branch plant on 20-acre tract of land at Houston, acquired several months ago. Proposed to begin work soon. A boiler house will be built. Entire project will cost about $350,000. Alfred C. Finn, Bankers' Mortgage Building, Houston, is architect.

Vt., Newport—Citizens Utilities Electric Co., has approved plans for modernization and improvements in hydroelectric generating plant. Cost reported close to $50,000. Work will be carried out at once. Charles T. Main, Inc., 201 Devonshire Street, Boston, Mass., is consulting engineer.

Wis., Marshfield—Electric and Water Department, R. F. Cramer, secretary, has plans under way for municipal power station, 42 x 100 ft. Estimates of cost and details are being determined. Helmick, Edeskuty & Lutz, Essex Building, Minneapolis, Minn., are consulting engineers.

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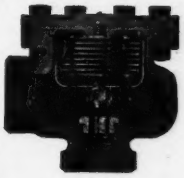

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HAND CONTROL vs VICTOR CONTROL

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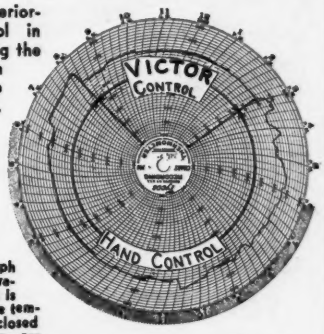

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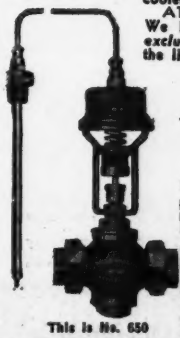

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